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Making Cylinders and Castings to Finish.

BY THOS. D. WEST

Steam cylinders are often complicated and difficult to mould, and when made they must be No. 1 castings. A flaw that would not injure many other machinery castings will condemn a cylinder. A cylinder casting may look perfect, without a visible flaw or dirt-spot before boring or cutting into the valve face, and yet when finished there may be flaws found that will send it to the scrap-heap. Experience has taught the writer to be shy of extraordinarily smooth-skinned cylinders. To be able to make a cylinder with such a surface, and at the same time have a perfect, sound, clean casting when finished, is an accomplishment worthy of praise. The way some get an extra smooth skin is by pouring the cylinders with what might be called dull iron. This is a risky plan to adopt just for the sake of an extra nice skin, as it is likely to sacrifice the soundness for the sake of the smoothness.

A cylinder should be poured as hot as it practically can be. The hotter it is poured the clearer and sounder it should finish. Cylinders are often poured with dull iron for no other reason than that the moulder is afraid of his mould; for if the iron is hot, it may find its way into the vents of the exhaust or port cores, and thereby set the casting blowing, or it may cut or scab his mould. Again, he may be afraid of a poor joint, or the mould or cores may have been burnt in drying. These are the main reasons given for pouring cylinders with dull iron, and in some cases the moulder is justified in considering them. By pouring dull he has less risk, and, considering all points, he keeps the most chances in his favor, and trusts to luck for the machine-shop test Some moulders can make a fine mould to look at, but the iron spoils it. A fine mould does not always insure a fine casting.

It would be impossible to state the many reasons why cylinders are lost in casting. Sometimes the plan of making the mould is all wrong, and sometimes the moulder's manipulations are wrong. Some will gate and cast a cylinder contrary to all reason. There are many who can make a good-looking unfinished casting, but when it comes to making a casting that shall be clean after the skin is removed, they are at fault.

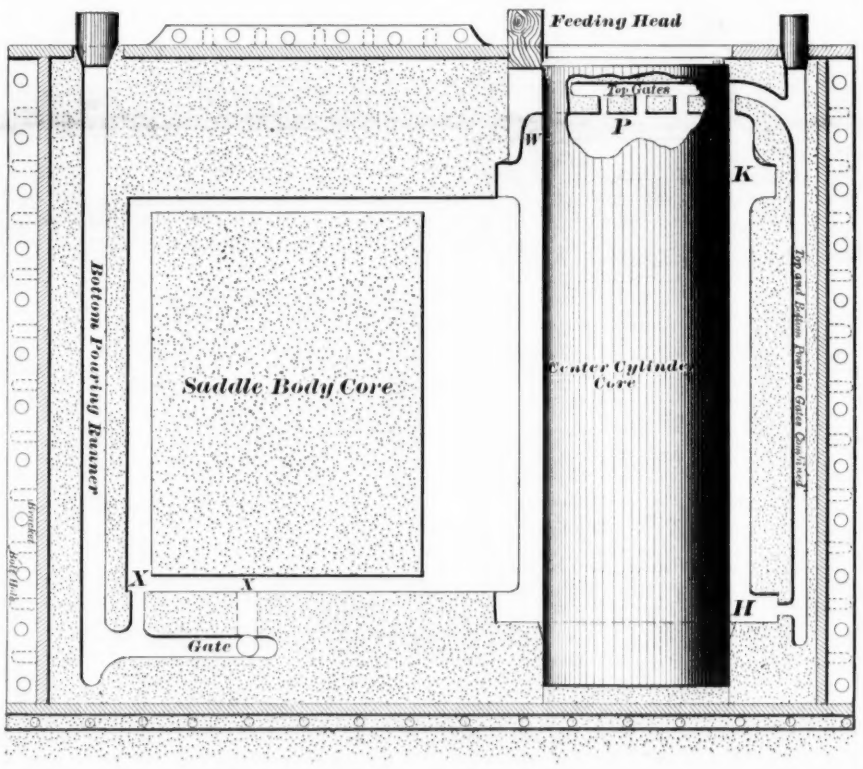
The science of making many sound finished castings can generally be told in a few maxims: First, make a mould that will stand fast and hot pouring: Second, a casting gated or poured by underneath, side or joint runners or gates had generally better be gated or run as far as possible from the portion required to be finished: Third, put good feeders upon the heaviest parts of the casting, and supply them with good hot iron until all the lighter parts are frozen up, and do not leave the heavy parts as long as the iron is liquid: Fourth, study the science of making runners and gates: Fifth, never forget that hot iron should make a sounder and cleaner finished cylinder than dull iron: Sixth, remember that dirt will rise and lodge under surfaces or upper portions of a mould.

In casting cylinders there are two ways practiced. One is to cast them vertically and the other to cast them horizontally.

A cylinder cast horizontally cannot be as sound as one cast vertically. In casting horizontally, more or less dirt must be caught and held by the underside of the center core, as shown at *A*.

Another objectionable feature of horizontal casting is that even if you should have the under portion of the core flattened in order to have stock enough to bore out all the dirt, the upper portion of the cylinder *B*, will contain more or less dirt, so that should the cylinder bore out clean it cannot be as strong as if it had been cast vertically. Green sand as well as dry sand moulds are included in this statement.

In making cylinders in green sand it is rare that they are cast other than horizontally, while with dry sand moulds they are cast in both ways. In loam they are always cast vertically, at least the writer never saw or heard of one being cast otherwise. Smoother castings are generally made in loam than in dry sand, and the smoothness of loam castings is not so apt to cover imperfections as in dry sand castings.

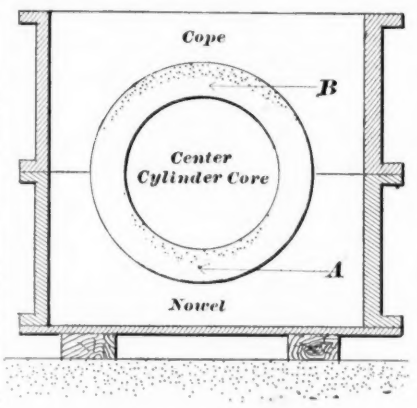


CYLINDER MOULD.

In pouring any casting there is more or less dirt; if it is not from the mould it will be from the metal, and these metal impurities will rise the same as dirt to the upper portion of the casting, the degree in which they will rise depending upon how fast the metal cools.

Hot iron is not as clean as dull iron. Take a ladle of hot iron and skim it clean, then let it stand for a few minutes and you will find the metal covered with an oxide, commonly called scum. This scum may be caused through oxygenation of gases. However, it is an impurity that when out of the metal renders it stronger. Tests which I have given prove that iron to be strong must be clean.

Some one may feel like asking, if it is true that dull iron is cleaner than hot iron, why it is that it will not make a cleaner casting? When a cylinder is condemned the fault is not usually in the iron. The trouble is there are places where there is no iron, nothing but dirt. If in the place of this dirt there was iron the casting would not be condemned. If there are holes without dirt the chances are ten to one that something foreign to the iron caused them. If the iron is porous or honeycombed, the cause is generally to be looked for in poor feeding or badly proportioned sections that are not reached by iron to take the place of that which is drawn away to supply the shrinkage of other parts.



Of course we have unsound and condemned finished castings, caused directly by the iron, but not so many as are charged to it. Holes containing sand show a fault in the moulding, either of the moulder or the manager. To keep these sand or dirt holes from appearing in sections that are not the uppermost parts of a casting when being made, the hotter the iron is poured the better. Hot iron will float and let dirt rise up through it quicker than dull iron. Of course we cannot destroy the dirt or sand by using hot iron, but by using it we are more sure of making the dirt go where it will do the least harm. The pattern-maker knows if any part of a casting is to be specially clean, he must make the pattern to mould, as far as plans will permit, so as to catch no dirt on that part, as the iron rises up in the mould, the parts required to be the cleanest being the lowest.

In pouring moulds that are largely composed of crooks and cores, there is always more or less dirt generated from the mould surface as the iron runs over it, and these very same crooks and cores may be so situated as to hold and catch dirt that we would like to have pass up into higher portions of the mould. Cores and crooks could often be so placed as to catch dirt and prevent it from getting to parts that require to be sound and clean.

All unsound castings are not to be laid to the moulder. Many patterns are made in such a way that the required perfect parts cannot be insured. The required parts to be finished should be so marked on the drawing, and before the pattern is made its construction should be based upon the best and surest way to make these parts sound. The foreman moulder should always be consulted in this, as he should know something of the matter. There are often little points which, when examined by the moulder and pattern-maker together, can be made to the profit of all concerned. One great trouble with some of our foundry foremen is that they cannot read a drawing, and so the pattern-maker has it all his own way, and when the pattern is about finished the foreman can then advise how it should have been made.

Returning to steam cylinders, the only reliable way to cast them so that they will come clean when finished is to cast them vertically, and generally to pour them from the top, as shown at *P*. In pouring from the top there are two advantages over pouring altogether from the bottom, as shown at *H*. The first benefit is that we have as hot iron filling the top portion of the mould as there is at the bottom. In pouring a cylinder all from the bottom the iron becomes duller the higher it rises. In pouring cylinders, if we can run or gate them so as to have the iron as hot in one section as in another, it is a good thing accomplished. Some may think that the plan shown of pouring the locomotive side-saddle cylinder is not consistent with the above, but with a little thought and close reading of the following, the moulder will see that the principle is one worth remembering. The side-saddle part of the locomotive cylinder is often filled with many crooked cores, and the thickness of iron around them is far less than that around the cylinder center core. By pouring the casting as shown at *X*, *X*, the metal is admitted into the thinnest sections, from which it runs to the heaviest, thereby giving a far more even temperature all over the mould than were the iron first run into the heaviest, and allowed to flow to the thinnest portion of the mould.

It may suggest itself that in pouring altogether from the bottom it would be better to have the metal enter as near as practicable to the main body of the cylinder, so as to get the hottest iron in the part that must be clean. In this way, it is true, you would get the hottest metal in the body of the cylinder, but there is nothing to arrest the dirt, which will make the casting unsound where it should be sound.

By pouring the saddle cylinder as shown, the liquid metal may be said to be filtered as water is by charcoal, there being so many cores, and the metal in this portion of the casting being the thinnest, nearly all the dirt and scum is arrested and does not enter the main body of the cylinder. So even if the iron is duller when it reaches the main body of the cylinder, it is at the same time cleaner. It may in some cases be advisable to have the metal drop from the drop (after the bottom is covered) in concert with that which goes in at the bottom.

The second benefit that is derived in pouring from the top is that the iron is all the time dropping upon the top of the rising metal. By thus doing it cuts up the dirt or scum in such a manner as to keep it upon the top, and keep it from gathering in lumps or rolling up against the side of the core or mould. In this way the dirt is kept floating upon the top of the rising metal, and thereby is brought up into the dirt-catcher or riser head, shown at *W*. Cylinders poured from the top generally have a rougher skin than those poured from the bottom, which is caused by the agitation of the rising metal. They are also more liable to be scabbed and cut than those poured from the bottom, but they will be clean when finished.

The plan here shown of having a gate running down to the bottom of the mould, with top runners attached to it in order to pour from the top as well as the bottom, is often a good one for dry sand cylinders, as by it you can start slowly to cover over the bottom of the mould, after which the gates can be filled and the metal be made to enter at the top as well as at the bottom. By first covering over the bottom of the mould, it prevents it from being cut by the falling iron. Some may say this is not necessary, for how is it that long water or gas pipes can be poured altogether from the top, and yet the bottoms not be cut? In pouring such castings, the iron is prevented from falling directly from the top to the bottom by the thinness of the space between the core and mould, the iron in dropping going from one side to the other and its friction decreasing its velocity. When such thin castings are scabbed, it is generally the sides of the mould, and not the bottom. With cylinders or pipes over one inch in thickness, the iron has a freer chance to fall directly upon the bottom, and thereby cut or scab it.

Cylinders similar to the locomotive side-saddle ones that have large foreign attachments cast on them are often better cast by having the metal go in at the bottom. Should such cylinders as these be poured altogether from the top, the sides of the mould all the way up would be liable to be cut or scabbed, or present a very rough body skin, caused by the attrition of the metal against the surface of the mould. The falling iron, instead of directly filling the body of the cylinder, runs away to fill up the side-saddle or the large attachments. In pouring any castings, the sooner the agitation of the metal against the mould's surface ceases, the better for the casting.

With reference to the general plan adopted in pouring cylinders in loam, they are usually poured from the top, while in dry sand the reverse is true. Often in both instances the top and bottom methods are combined; especially so when the cylinder is over four-foot stroke. There are other points about cylinders that require to be as perfect as the bore, which, for the present, I will not dwell upon.

The successful making of cylinder castings is an art that the best men in the business have given much thought and study. Some have succeeded, while others have not, and a thorough, practical study of perfect cylinder-making will hurt no one, for its principles are such as can be applied to nearly all sound and clean-finished castings.

In fact, there is this to say of studying up any special subject in moulding, as in other mechanical matters: The information gained cannot be all charged against the job in hand, as it will not infrequently, and perhaps when least expected, be found of even greater value in some other direction. Knowledge has the advantage of almost unlimited application, and will render an equivalent for time spent in its acquisition.

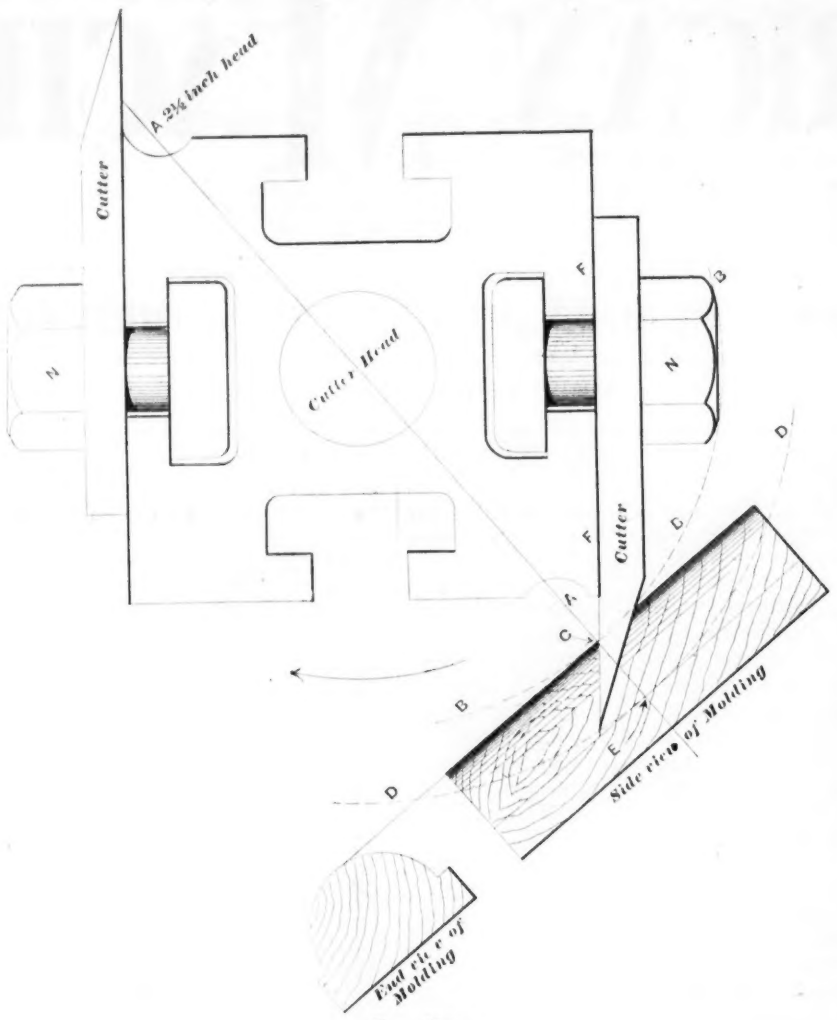


FIG. 290.

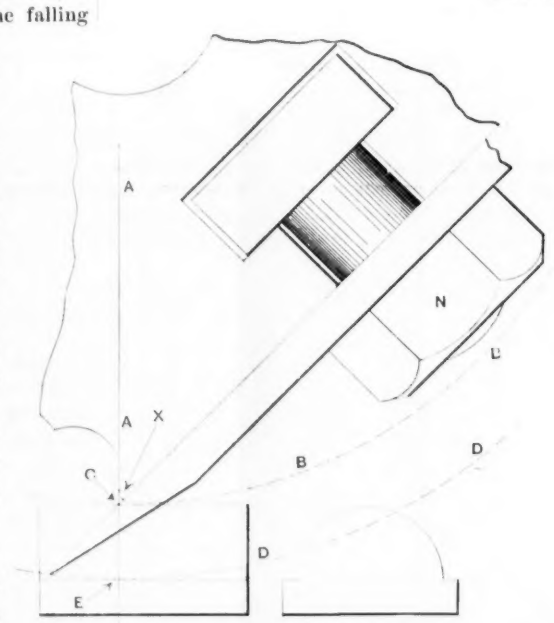


FIG. 291.

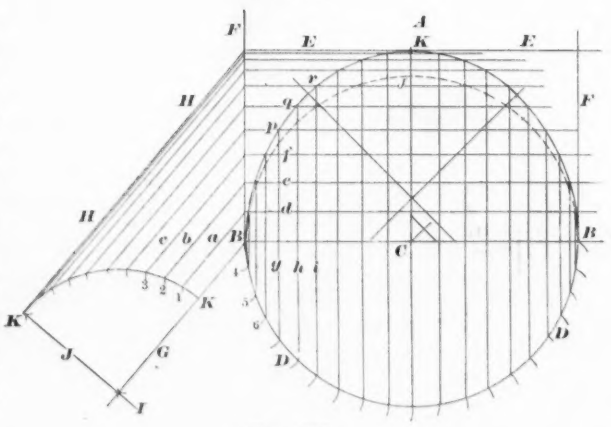


FIG. 293.

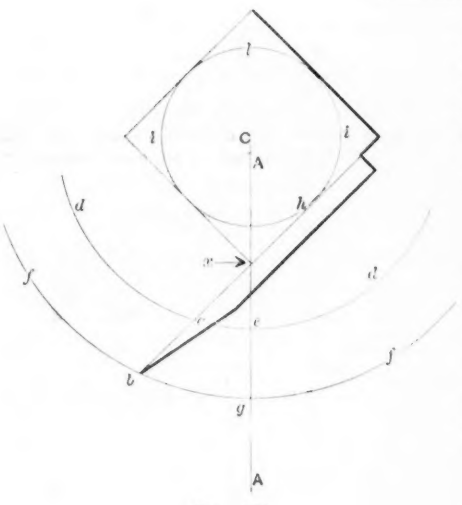


FIG. 292.

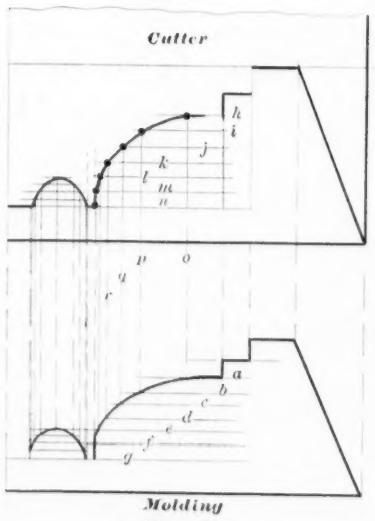


FIG. 294.

Method of Finding the Shape of Moulding Machine Cutters.

Of late we have had a number of communications discussing methods of finding the proper form for the cutting edge of cutters for moulding machines to produce mouldings of any given pattern, or from a sample.

Through the kindness of the author, we are permitted to reproduce the following elucidation of the subject, with engravings, from the new book, entitled "Mechanical Drawing Self-Taught," by Joshua Rose, which was reviewed in our columns quite recently:

"In Fig. 290 is shown a cutter-head for a wood moulding machine, and it is required to find what shape the cutting edge of the cutter must be to form a moulding such as is shown in the end view of the moulding in the figure. Now the line *A A*, being at a right angle to the line of motion of the moulding as it is passed beneath the revolving cutter, or, what is the same thing, at a right angle to the face of the table on which the moulding is moved, it is obvious that the highest point *C* of the moulding will be cut to shape by the point *C* of the cutter; and that since the line of motion of the end of the cutter is the arc *D*, the lowest part of the cutter action upon the moulding will be at point *E*. It will also be obvious that as the cutter edge passes, at each point, in its length across the line *A A*, it forms the moulding to shape, while all the cutting action that occurs on either side of that line is serving simply to remove material. All that we have to consider, therefore, is the action on line *A A*.

"It may be observed also that the highest point *C* of the cutter edge must not be less than ¼ inch from the corner of the cutter-head, which gives room for the nut *N* (that holds the cutter to the head) to pass over the top of the moulding in a 2½-inch head. In proportion as the heads are made larger, however, less clearance is necessary for the nut, as is shown in Fig. 291, the cutter edge extending to *C*, and therefore nearly up to the corner of the head. Its path of motion at *C* is shown by dotted arc *B*, which it will be observed amply clears the nut *N*. In practice, however, point *C* is not in any size of cutter-head placed nearer than ¼-inch from corner *X* of the cutter-head.

"To find the length of the cutter edge necessary to produce a given depth of moulding, we may draw a circle *i*, Fig. 292, equal in diameter to the size of the cutter-head to be used, and line *A A*. The highest point of cutting edge being at *e*, and the lowest at *g*, then circles *d* and *f* represent the line of motion of these two points; and if we mark the cutter in, the necessary length of cutting edge on the cutter is obviously from *a* to *b*.

"Now, the necessary depth of cutter edge being found for any given moulding, or part of a moulding, the curves for the edge may be found as follows: Suppose the moulding is to be half round, as in the end view in Fig. 290. The width of the cutter must, of course, equal the width of the moulding, and the length or depth of cutting edge required may be found from the construction shown in Fig. 292; hence all that remains is to find the curve for the cutting edge. In Fig. 293, let *A A* represent the center of the cutter-width, its sides being *F F'*, and its end *B B*. From center *C* draw circle *D*, the upper half of which will serve to represent the moulding. Mark on *A* the length or depth the cutting edge requires to be, ascertaining the same from the construction shown in Fig. 292, and mark it as from *C* to *K'*. Then draw line *E E*, passing through point *K*. Draw line *G*, standing at the same angle to *A A* as the face *h b*, Fig. 292, of the cutter does to the line *A A*, and draw line *H H*, parallel to *G*. From any point on *G*, as at *I*, with radius *J*, draw a quarter of a circle, as *K*. Mark off this quarter circle into equal points of division, as by 1, 2, 3, etc., and from these points of division draw lines, as *a*, *b*, *c*, etc.; and from these lines draw horizontal lines *d*, *e*, *f*, etc. Now divide the lower half of circle *D* into twice as many equal divisions as quarter circle *K* is divided into, and from these points of division draw perpendiculars *g*, *h*, *i*, etc. And where these perpendiculars cross the horizontal lines, as *d*, will be points through which the curve may be drawn,

three of such points being marked by dots at *p*, *q*, *r*.

"When the curves of the moulding are not arcs of circles, they may be marked as follows:

"Take the drawing of the moulding and divide each member or step of it by equidistant lines, as *a*, *b*, *c*, *d*, *e*, *f*, *g*, in Fig. 294; above the moulding draw lines representing the cutter, and having found the depth of cutting edge for each member by the construction shown in Fig. 292, finding a separate line, *a b*, for each member of the moulding, transfer the depths so found to the face of the cutter; divide the depth of each member of the cutter into as many equal divisions as the corresponding member of the moulding is divided into, as by lines *h*, *i*, *j*, *k*, *l*, *m*, *n*. Then draw vertical lines, as *o*, *p*, *q*, *r*, etc.; and where these lines meet the respective lines *h*, *i*, *j*, etc., are points in the curve, such points being marked on the cutter by dots."

Extracts from Chordal's Letters.

INDIVIDUAL JUDGMENT IN VERTICAL ENGINE MATTERS—A FREE LECTURE THAT PAID—PATENTS IN MANUFACTURING—KINKS BUILDS A HOUSE ON ANOTHER MAN'S LOT—QUICK RETURN PLANERS—A HYDRAULIC PLANER—LEATHER FRICTION FEEDING—TRAVELING TOOL PLANERS—ENGLAND AHEAD ON BIG WORK.

Mr. Editor:

* * * When the intelligent machine designer goes to get up a vertical steam engine, about the first thing he does is to determine which end up to put it. He applies all the known formulæ for stability, and momentum, and vibration, and finally decides that the cylinder must go up and the shaft must go down. The question is settled, and properly. Another man, but just as likely as not the same man on another job of a similar kind, will undertake the solution of the same problem. He will deal with the same forces, apply the same formula, and reason in the same manner. Lo and behold, he puts the cylinder on the lower end and puts the shaft above. Such is the reign of law.

* * * Peter Cooper is dead. He was a man who belonged to the class that had no show. He was a mechanic; worked at carriage making; was an apprentice for $25 a year, and as a journeyman I suppose he got the commonest kind of wages. When I was about five years old, Mr. Cooper was able to arrange for a free gift to the people of New York—something which cost him about a million dollars—namely, the Cooper Institute. The only lecture I ever listened to which I have since thought was worth money to me was a free lecture on zinc in the chemical room of this same institute.

* * * The subject of patents as they relate to manufacture ought to have a good, thorough explanation in your columns. Very often I notice letters from some ingenious mechanic who has devised some excellent contrivance which, with a commendable spirit of liberality, he proceeds to explain to the public. He is fairly and honestly an original inventor, never having seen anything of the kind before. But it does not follow always that he is the first inventor, or that it is in his power to give the thing to the public. If he has not the title, he has nothing to give except the idea, and in case some one else has the title, an innocent public is worse off in having been misled by the innocent donator. These things are, of course, bound to happen once in a while, and there seems no way to guard against them.

As an instance of this kind, I notice in the AMERICAN MACHINIST for April 21st among the Letters from Practical Men one signed "Kinks," describing a nut mandrel for facing nuts true with the thread, regardless of how crooked their rough faces may be. This letter winds up with, "There is no patent right about this, anyone being at liberty to use it." The probabilities are that Mr. Kinks invented this nut mandrel and found it to be an excellent contrivance, as anyone has who has ever used it. But to my personal knowledge it was invented years ago and covered by a patent, and anyone following the well-intended advice of Mr. Kinks will stand a chance of getting into trouble.

* * * There is a rumor in the air that some of the Philadelphia tool-builders are now ciphering on a planer which will hurry back. It is about time that something of this kind was done. If there is any particular standing shame attached to the art of working cold iron, it is the comparative slowness with which the idle stroke of reciprocating tools is made. The planing machine of Whitworth was operated by means of a screw. This is a sluggish sort of a contrivance, and one most excellently adapted for a smooth cut, but it was never possible to get very high speeds on the back stroke. Whitworth devised the reversible tool which turned clear round at the end of the stroke, so that the planer took a cut while running backward, the speed in both cases being then, of course, the same. This reversing arrangement is of practically no utility on ordinary work, owing to the accuracy required in setting the tools. It has never been adopted by any tool builders in this country.

A Worcester concern—Wood & Light, if I am not mistaken—got up a planer in which the housings were parallel uprights with an ordinary rail upon each of their faces. The appearance was similar to two planers with their tail-ends cut off and backed up close to each other to work upon a single job, with two tools, one cutting in each direction. It will be seen that for a good-sized planer this involved a housing breadth of about three feet, or say four feet from tool to tool. In order to get any work out of the extra tool, it became necessary to run the job four feet further than usual. A proportion existing between these four feet and the length of a given job compared with a proportion between the forward and backward speeds upon an ordinary planer would show whether there was any value in the arrangement. On ordinary short jobs there is obviously a loss of time as compared with an ordinary single tool planer. This tool has never come into general use and probably never will.

* * * The average New England planer is a spur-geared planer, and is driven by one belt, which is alternately shifted to the back and forward pulleys which are necessarily both of the same size, as is also the counter pulley which drives the belt. The backing speed is made faster by means of a quicker gearing train driven by the backing pulley. The maker, of course, arranges this proportion of speeds to the best of his judgment, but after the machine is built this proportion must stand forever.

* * * The Philadelphia system of planer building involves the use of two belts driven from different size pulleys upon the countershaft. The builders send out countershaft pulleys adapted to give a proportion between forward and backing motion which in their judgment seems best. The proportion thus hit upon by the Philadelphia builders will be substantially the same as the proportion hit upon by the New England builders. If the purchaser of the planer thinks it will bear running backward faster, he can easily put a larger pulley on the countershaft and demonstrate the wisdom or the folly of his thought.

I am probably somewhat in error in speaking of the New England planer as a one-belt planer, because, if I am not mistaken, planers of the larger sizes now built in New England are fitted for two belts.

* * * A planer of fair dimensions which will run back twice as fast as it will run forward is doing tip-top, but still it is wasting exactly one-third of its time. There are not many planers which do this well. The Philadelphia men, I understand, propose a planer to run back at 60 feet per minute, or say three times the cutting speed. Such a planer would waste but one-fourth of its time. This is slamming planer tables around pretty lively, but I hope to goodness that whoever is at it will succeed in doing it satisfactorily.

* * * This reminds me that I once made drawings for a planer for certain special work in chilled iron. The ordinary backing motion would have been in this case a matter of but trifling loss, but while I was at it I thought I would make a tool that would cut practically all the time. I set the planer on end, intending to have it cut on the up stroke and then let go and tumble back as fast as the laws of nature would let it. This was all on paper. I was afraid to risk it in iron, because I didn't think the planer would ever succeed in making more than one stroke.

* * * This again reminds me that some years ago there was devised in England a planer driven by hydraulic pressure on a piston attached to the bed. Whether the idea ever got a fair demonstration or not I don't know. But no inherent defect in the system has occurred to me. The inelasticity of water should yield a firm and smooth cutting stroke. The expense would be no greater than a geared construction, and the mechanism would be less complex than that at present in use. There would be liquid and slopping, but the modern system of planers involves lots of liquid and slopping anyhow. This hydraulic business may not bear analysis, but on its face there is something attractive.

* * * The old style of planing involved slow speed and fine feed. It took little power to do the feeding and this power could be gotten from leather frictions. These frictions could be rubbing away all the time during the stroke, but as there was little power in them, so also there was but little resistance, and this waste of power during the non-feeding time was hardly worth inquiring into. Those old planers would seldom feed more than a 1-16th or a 3-32d to the cut. Now, however, the people demand planers which will take a sliding cut with $\frac{5}{8}$" or $\frac{3}{4}$" feed to the cut. This requires a rail screw to be twisted round two or three times without wasting any time about it.

This lightning-twisting operation requires lots of power; entirely too much power to be unnecessarily exerted during the non-feeding periods. So far as my experience goes, the leather friction is a grand fizzle for this kind of feeding. Recourse must be had to some positive mechanical contrivance which will take hold with a firm grip and do any amount of feeding as quick as a flash, and then let go and wait till it is called on again. Such a movement involves some of the finest problems in mechanurgy. Many a man has busted his head over the thing and got it fine, all but one little point probably, and that little po'nt vital to its operation.

I think, Mr. Editor, if you would illustrate any one of the planer feed mechanisms of this class you could make some thoroughly interesting reading. Not as a subject relating to planers, or to machine tools, but simply as an example of problematical machine construction As far as I know there have been but four or five devices contrived which would accomplish the desired result. Contrivance is hardly the word – invention of the highest possible order is involved. If I can find one of these things, and a description of it won't advertise somebody, I will send it to you. You understand, of course, that in the opinion of some people it is the business of a newspaper to guard against being of any value to any one.

* * * While on the subject of planers, how ridiculous it seems to take an immense planer table, and pile on it a big, long job, the whole thing weighing a hundred and some odd tons, perhaps, and then churn that immense thing backward and forward past a trifling little cutting tool for hour after hour. How much more reasonable it is to think of the massive work lying still, and the little tool walking along it like a carpenter's gauge on the edge of a long board. I have never been over the water, but I understand that some of the tool-building shops over there use some such jack-plane arrangement in connection with long work. In the ordinary plate planing machines, for dressing the edges of boiler plates and such like things, we have an example of a traveling tool taking long journeys. But these machines are no in very general use, and are but little known.

Mr. John Richards lately got up a shaping machine, which was also arranged to act as a traveling tool planer. I believe this machine has been illustrated in your columns. I don't remember what name was given it, or which of its features, planing or shaping, was considered the primary one.

* * * From what I can understand of the English, they are way ahead of us on ingenious contrivances for big work. Our American systems of labor-saving machinery and devices are, probably, in a general way, the most marvelous and perfect in the world. But when work begins to weigh 10 lbs., this whole system quits. Many large manufacturing concerns can show some special machines for doing lots of work on big pieces, but when we come to look deeper into them, we find that they are nothing but a double-headed arrangement, or some such plan as that, by which two machines work on a single job at once. To this general class of machines belong connecting-rod planers, double cotters, bridge-link drills, locomotive-frame drills, driving-wheel lathes, car-axle lathes, etc.

I understand that the English will sometimes take a massive piece of metal, stick it into some immense machine, do fifteen or twenty things on it, and take it out done.

* * * There is an impression prevailing in some sections of this country that the Yankees build a machine into which you drop a live hog, and it comes out in barrelled pork, sugar-cured ham, lard in tin cans, and the best of bristle scrubbing brushes. I have never believed this story, because a hog is a pretty heavy article.

Very respectfully,

CHORDAL.

It is announced that Mr. Brush has so far improved his storage battery as by its use to be able to compete with gas in incandescent lighting. An important advantage claimed for the storage battery is that incandescent and arc lighting can be accomplished from the same plant. With the storage battery, the irregularity of the charging is of no consequence, and in arc lighting a current that would be too irregular for incandescent lighting may be employed. Hence it is claimed that the current used for arc lighting may be employed for charging the batteries. The plan is to locate batteries in buildings wherever convenient, and use them for lighting purposes or for driving small motors. At the same time, and in opposition to the theories advanced by those who favor the use of storage batteries, it is said that they are a failure, and that, in any event, the attempt to use them to any extent will be the signal for the commencement of important suits at law to determine the ownership of patents upon them.

A little more—sometimes a good deal more—mechanical courtesy would always be a pleasant thing, and frequently a good thing otherwise. One gains nothing, ordinarily, by devoting himself to the task of belittling the efforts of others. What is of general interest is what one can do himself, not what another cannot do. Buyers of machinery, for instance, are always interested in knowing a good deal about the products of a manufacturer, and but little interested in knowing a manufacturer's individual opinion about what some one else manufactures in the same line What is true in this respect is equally true in respect to many other mechanical matters. Courtesy towards others, and respect for their opinions generally pays.

The managers of the Chicago Railway Exhibition have sent out a special circular to exhibitors calling their attention to a rule which requires allotment of space to be occupied on or before May 20th. It is their determination to have everything in readiness on the opening day. Indications point to a very large attendance.

It is announced that the next session of the American Society of Mechanical Engineers will begin at Cleveland, Ohio, on Tuesday, June 12th.

Olsen's Improved Nut Tapper.

The improved nut tapper, represented by the accompanying engraving, is made by the Indianapolis Machine and Bolt Works, 77 to 89 South Pennsylvania street, Indianapolis, Ind.

One of the principal designs about the nut-tapping machine here shown, is a mechanical arrangement to prevent the breaking of gears, as well as the twisting off of sockets or taps. The arrangement consists in making all the parts sufficiently strong, and of driving the spindle by means of a small gear driven by a larger gear, both of which are bevel gears It is claimed that should a tap fail to cut its way through the nut, or catch, because of an excess of material to be removed by the tap, the belt will slip off the cone before any of the parts will give way. This is a feature which will be readily comprehended by the mechanic who has had any experience with nut-tapping machines or bolt-cutters. By an ingenious arrangement of the chuck the operator can readily detach the tap without stopping the machine. This is done by grasping the chuck and pushing it up with the hand. If through any carelessness of the workman more nuts should be placed upon the tap than the blank part will retain, by an automatic device the tap will be released, when it drops from the socket. Thus a considerable loss of taps through breakage is prevented.

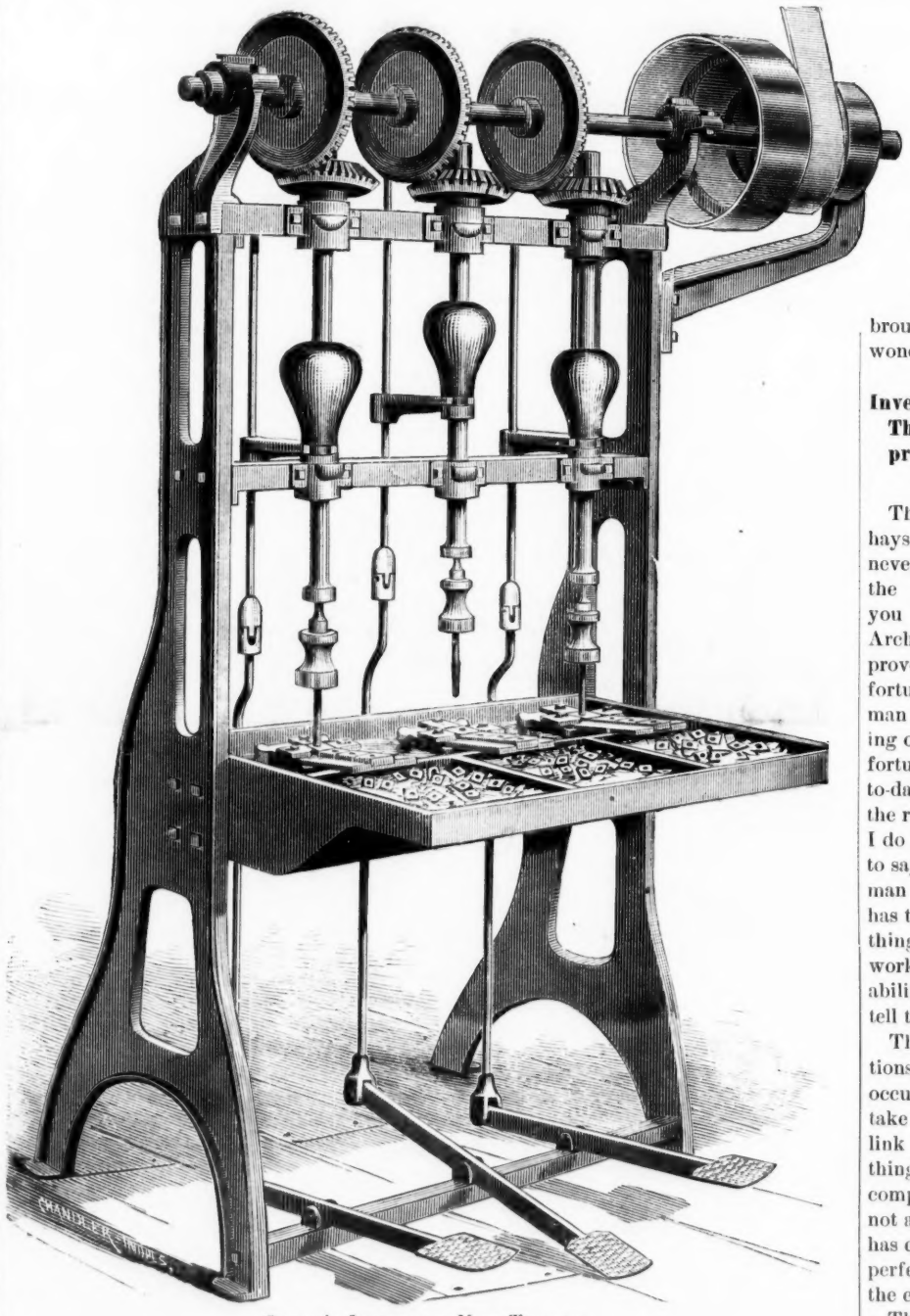
If the directions given for operating these machines are observed, it is claimed that the common annoyance from slipping belts and of excessive belt tension will be entirely obviated.

This machine will tap all sizes of nuts from $\frac{7}{8}$-inch downwards, and will tap three nuts at one time.

It occupies a small floor space in comparison to the work that it will do.

The cone pulley has three changes of speed to be used in attaining an economical speed for tapping all sizes of nuts within the limit specified.

When desired, this nut tapper is made with compound gears that will tap all-sized nuts from $1\frac{3}{8}$" downward. The engraving shows all of the other essential features in one of the most simple forms, so that any one—a boy, for instance, of ordinary intelligence—can operate it.



OLSEN'S IMPROVED NUT TAPPER.

According to *Ironmonger*, the Vienna Town Council has resolved to hold an International Exhibition next year of articles appertaining to the city improvements, and have voted a sum of 100,000 florins to assist in carrying out the purpose. The municipalities of all the towns of Europe, America and Australia will be invited to take part in the exhibition.

Foundations for Stationary Engines.

We reproduce the following brief directions for placing stationary engines upon suitable foundations from the catalogue of the Lane & Bodley Co., of Cincinnati:

"The foundation for an engine designed to be a fixture should receive careful attention. They are generally of brick, but sometimes of stone, and vary in depth from five to six feet, projecting about two feet above the floor line. The engine may be supported immediately over the excavation one-half inch higher than it is finally to rest. The foundation bolts, with the nuts just started on the thread, may then be hung through their proper holes in the frame and built into the masonry at once. It is well to leave a pocket in the masonry for each bottom nut, and build masonry one and a half to two inches away from the bolts all around After the engine is in place, and bolts entered in the engine frame, fill the hole left around bolts with grout, so as to make a solid mass. Whether of brick or stone, every piece laid should be firmly bedded and each course well grouted. Build to within one-half inch of the bottom of the frame, and fill the intervening space with cement. Draw out the supporting timber, and screw down on one or the other of the foundation bolts, as required, to level the frame, and upon all of them until finally the frame is well bedded in the cement; the edge may then be neatly beveled. The crank shaft may then be put in and squared by measuring from the face of the crank, near the edge, to the inside edge of the top of the frame. The distance from each edge of the crank to this is the same, when the shaft is square with the center line of the engine. Level the shaft and bolt the outer box to it in its proper position, and with the bottom level, hang the bolts through, and build as with the engine frame. The foundation should be wide enough to allow a full brick or a moderately wide stone outside the bolts, on the top course The bottom course should be considerably wider than the top, with the sides battered. If a template is used, proceed in general as before described, but use the template in place of the engine frame, taking into consideration the thickness of the bottom flange of engine frame when adjusting the bolts for height. Be sure that the holes in the templates are just the size of the bolts, and not the size of the holes in the casting, and that the centers of the holes in the template agree exactly with the centers of the somewhat larger holes in the casting. Be sure that every course breaks joint with the one below. If a stone coping is used, bed it thoroughly in cement. Do not wedge under it to level it. A drawing, showing engine setting in connection with boiler and pump, will be furnished customers upon application with their order."

In considering the question of who should decide on the plan for an increase in the water supply which is best for the city, we regret to see a suggestion that the matter be submitted to the American Society of Civil Engineers. This is all wrong. This representative society of engineers was not organized for, and should never be debased to, the gratuitous discussion of special projects, nor should it be brought into the arena of politics. The adoption of plans and the selection of men to carry them out are not the proper functions of an association of scientific men, the members of which are scattered from Nova Scotia to Japan, and are dependent upon their scientific knowledge and experience for their livelihood, and who belong to the society, not for the pecuniary profit it may bring, nor with the purpose of electioneering for nominations to office, but for the professional and social advantages they may derive from intercourse with their fellows, unhampered by the feeling that each man he meets or addresses may be a rival, seeking a weak spot in his armor or an opportunity to pilfer a good idea. The American Society of Civil Engineers has shown itself before now to be jealously guardful of its true exalted position, and we feel sure that its members would, with one accord, decline to have it made an arbiter on special professional questions.—*Sanitary Engineer.*

There are certain cities that appear to be particulary unfortunate in the matter of labor troubles. Reading, Pa , seems to be one of them. Most of the items of general news from Reading refer to strikes, rumors of strikes, or disagreement of some kind regarding wages or shop regulations. Reading is an enterprising manufacturing city, and there is no reason publicly mentioned why it should not be as free from labor troubles as any other city of its size.

Two ingenious Frenchmen have invented a scythe whetting machine, which we find described to the extent of a column in one of our English exchanges. It embraces, altogether, an anvil, a hammer, ratchet wheel, coiled springs, gearing, crank, roller, shaft pinion, &c., mounted upon a tripod which "has cast iron legs and wooden cross pieces." According to the article referred to "the whetting of scythes, as heretofore practised causes a great deal of fatigue and loss of time, and imperfect whetting by inexperienced work people, disfigures the scythe, and renders the working defective." This machine, it is claimed, obviates all those difficulties, and enables "even a child" to effectually perform the operation. We are not told whether an additional harvest hand is required to transport and operate this labor saving machine, or whether each mower is expected to carry one strapped upon his back like a fire-extinguisher, and to mount it and wind it up whenever the scythe gets dull. Perhaps, however, it is intended to have it erected in one corner of the field so that whenever a scythe needs whetting all the workman has to do is to walk over to the machine, see that it is properly oiled and free from dirt, grab the crank with one hand and feeding in the scythe with the other hand, vigorously run the thing of gears, springs, &c., until a good edge appears upon the instrument, then walk back (possibly an average walk of only a quarter or a half mile for each sharpening) to his work. Doubtless these two French mechanical geniuses had become impressed with the laboriousness of scythe whetting while lounging in the shade of some convenient tree, and watching the overburdened harvest men put keen edges upon their trusty steels. Hence the inception of this great boon to farmers. When we attempt to look over the multitude of time and labor-saving inventions, of this valuable character, brought out every year, we are seized with wonder and amazement.

Inventing Things that are Not Needed—The Link Motion and How to Improve It.

BY J. EDSON.

Those of us who have spent a good deal of hayseed ingenuity in inventing things that never wanted inventing, can best appreciate the force of your editorial wherein you depict the success of the infant Archimedes who was going to improve the Corliss valve gear. How fortunate he was to fall into the hands of a man who set him right before the squandering of the other man's money! And how fortunate it would be if many inventors of to-day could hit the right man first! But the right man is not always so easy to find. I do not mean simply the man who is ready to say your invention will not work, for that man is always at hand, but the man who has the knowledge to determine whether a thing is new or old, whether it is likely to work or not, and then the man who has the ability to explain why, and the courage to tell the inventor that it is a waste of time.

This spending money to develop inventions that ought not to have been invented occurs every day, and just now it seems to take the direction of some substitute for the link motion. Now, why substitute something for the link motion? Does it not accomplish all that is required of it, and is it not about as perfect a piece of mechanism as has ever been devised? Not that it is always perfectly constructed, but does it not possess the elements of perfection?

Theoretically there are two minor defects in the ordinary link motion, one of which can be completely remedied, and the other corrected to a certain extent. The first is the twisting thrust given to the link, due to the fact that the centers of the eccentrics are not in line with the center of the link. A plan was proposed in the *American Artisan* some nine or ten years ago by which it was avoided. One eccentric was to be set in line with the link, with two other narrow eccentrics set one on each side of the first, with the eccentric rods joined together. This plan is at present used by some English engineers in their reversing rolling-mill engines.

The other defect is the supporting of the link by a single side attachment. Possibly with the double eccentric rod at the upper end of the link, it (the link) may be supported centrally by the supporting rod passing down between the two eccentric rods and pivoted in a slot in the link itself.

The link motion with these changes would be perfect, and without them is likely to be a hundred times better than the ingenious combinations devised as a substitute.

Belts—Conditions Affecting Power Transmitted—Quarter-Turn—Idler Pulleys.

BY CHARLES A. HAGUE.

We have had occasion to question different belt manufacturers as to whether they would guarantee their belts to drive a certain load. Some of them would guarantee, and put it in the form of a contract, but upon being interrogated as to the method by which they computed the power to be transmitted by any certain sized belt, the answers were generally very indefinite and varied. When it comes to writing and signing a contract that means anything, a majority seem to lack confidence.

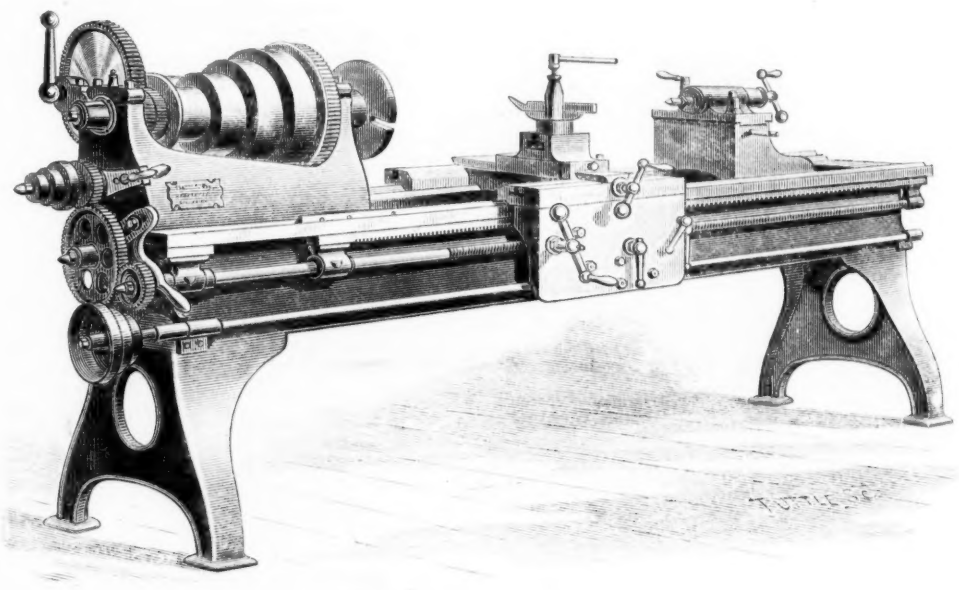
It is surprising to observe what a difference the single factor of speed makes in the power transmitted. A shaft is driven by, say, a 20″ belt upon a certain sized pulley. By a comparatively slight reduction in the diameter of pulleys, it will require two belts the width of the first to re-transmit the power to other lines. Again, the limits of strength are varied by conditions as numerous as those pertaining to widths. With a good-sized single leather belt, laced, for example, the driving force depends upon the quality of the contact and the pressure of the belt upon the pulleys. The pressure depends upon the weight of the belt. The weight for any assumed width depends upon the length. The length it is possible to employ depends upon the strain that can be held by the lacing without too large an item of repairs. We may cut out the lacing, rivet and glue the joint together, and then look for the limit in the strength of the laps. The laps growing weak, take off the single belt and put on a double one. Now, the weight is doubled, the driving force upon the pulleys is increased, and a greater load can be driven; but the first thing we know, the pressure upon the pulleys, caused by the long heavy belt, is resulting in more loss by friction of shaft bearings than is gained by the increased driving power. The horse power transmitted is increased, to be sure, but the means by which the addition is accomplished, that is, the weight of the belt, appropriates more of the increase than is exerted for the benefit of the belt owner.

It has been stated that, "the resistance of a belt to slipping is independent of its width," but we beg to demur, and in support of our position would remark that after any certain width of belt has been applied for driving a certain load, another belt of the same dimensions and under the same conditions, can be put on along side of the first one, and thus double the power may be transmitted, and, practically, under ordinary good conditions, it would make but little difference whether the double width was composed of one belt or two, although there would be a slight advantage in bedding to the pulleys where two belts were employed. This matter of bedding to the pulley explains why a narrow belt will sometimes drive better than a wider one, and is an argument in favor of using as narrow belts as possible. Very often the power can be increased by narrowing the belt and increasing the size of the pulleys, thus increasing by a single operation the value of two factors, viz., the driving force upon the pulley, and the speed of the belt. If instead of placing the second belt by the side of the first one, we should place it on top, we should fall considerably short of driving a double load, leading us to suppose that, although the action of belting is somewhat embodied in the laws of friction, we may often very easily be mistaken in supposing in some certain cases, that the pressure is very greatly increased, or that an equal amount of material will produce the same results under all conditions.

To illustrate the effect of different widths: Suppose two different machines driven from opposite ends of a line shaft, each requiring 10 H. P. Now, if the two belts were just sufficient for the work, and we take the belt off one machine, and by bringing the machines into a position in which they could be connected to each other, it must be evident that the remaining driving belt would be insufficient for the operation of both machines; but by now doubling the width of the driving belt and pulleys, we would practically restore the position as first set forth.

When a line of shafting is to be driven from another line in a room above or below, the placing of the shafting and pulleys is a matter of considerable importance, especially if the lines of shafting so connected are at right-angles to each other. The proper manner of doing such work is to correctly determine the location of hangers, shafting and pulleys, and put them up permanently in place at once, thereby avoiding experimenting and changing about. One of the most important matters to be looked after in locating a pulley is the direction in which the pulley will deliver the belt. When a pulley once gets a fair hold, it will do all that can be expected; but in order that it may get this fair hold, the belt must be delivered to it in a proper manner from the other pulley with which it is connected. This, of course, is true of both pulleys. Bearing this in mind, then, the main thing to look to in placing shafting for a quarter-turn belt is the manner in which each pulley delivers the belt to its mate. The shafting must be perfectly level, and the relative speeds of two lines so connected should be, wherever possible, such as to require the two pulleys to be of the same diameter, or nearly so. This, of course, is not imperative, but a quarter-turn belt does not work at its best when running from a small pulley to a large one. The main principle to be maintained is, that the center of the *delivering faces* of each of the two pulleys must be made to touch the same plumb-line. The positions of the pulleys may be slightly changed by slipping them along the shaft to suit certain conditions, such as a short distance between the two shafts or great difference in diameter of pulleys, and sufficient room may be allowed for this adjustment when the hangers are located; but if the shafting is placed with reference to the plumb-line, a very little adjustment will suit most cases. The best results, however, will be obtained when the pulleys are of the same size, and not greater in diameter than twice the width of the belt. The distance (vertically) between centers of shafts should not be less than three feet for every inch in width of belt. When the distance between centers comes within eighteen inches for each inch of belt width, it does not pay to use such a belt, and under any circumstances the narrower the belt capable of doing the required work, the better. It may be well to remark that when the plumb-line principle is employed, the two lines of shafting may be at any horizontal angle.

Supposing that one of the lines of shafting is in place, the location of the other line and the two pulleys for transmitting the power may be determined as follows: Drop a plumb-line from the shaft already up, at two different points, say ten feet apart, and draw a chalk mark on the floor from one point to the other, so that the chalk line will be directly under the center of the shaft. This mark must correspond with that portion of the shaft upon which one of the pulleys is to be placed. Now mark upon the floor a parallelogram corresponding in dimensions and position with the diameter and face of the pulley. Having determined in which direction the shaft is to revolve, and supposing this first line is in the lower room of the two, make a mark at a point on the parallelogram corresponding to the center of width of the face which *delivers* the belt. Ascertain, by measuring from the building walls, the location of a point on the floor above approximately over the mark on the parallelogram, and cut say a six-inch hole in the upper floor. Now, by means of a plumb-line, locate upon a small strip of wood placed across the hole in the upper floor a point directly over the center of the delivering pulley face below, and this last mentioned point will represent the center of width of the delivering face of the upper line shaft pulley. By marking a parallelogram upon the upper floor corresponding with the dimensions of the pulley, the center line of the shaft may be readily observed. It matters not at what angle the upper line of shafting is to the lower one, for with the point upon the upper floor determined by the plumb-line for a center, the parallelogram representing the pulley may be swung round in any direction. Having drawn a line upon the upper floor to indicate the direction and position of the upper shaft, it only remains to put up the shaft to correspond.



TWENTY-TWO INCH SWING LATHE.

Having located and put up the shafts and pulleys, it is equally important to know how to place the belt, and mistakes are not infrequently made in this direction. The belt must be led from the delivering face of the lower pulley to the *receiving* face of the upper pulley, and from the delivering face of the upper pulley to the *receiving* face of the lower pulley. In first attempts it is sometimes led from the delivering face of one to the delivering face of the other, or so as to directly connect the two faces touching the plumb-line, but it must be obvious that a belt would run off the pulleys as soon as motion commenced under such conditions.

Some one has said that idler pulleys are "a poor excuse for poor engineering," and perhaps with a great deal of truth; but if we attempt to draw too severe a line in these matters, we may find ourselves drifting towards impractical extremes.

It is sometimes necessary to either carry a belt under a timber or partially cut away the timber, and the timber may be in a place forbidding the idea of introducing an element of weakness. All that remains, then, is to place a good-sized idler pulley so as to steer the belt clear of the timber or other obstruction, even though it may be the tight side of the belt. Such an appliance is both practical and useful. There is certainly no objection to carrying extremely long belts upon idlers for the purpose of steadying them, and of relieving the shaft journals of some of the pressure due to a very long belt. An idler may also be used with advantage upon the slack side of a belt to steady it and hold it to the pulleys; or it would not be amiss, where the belt is near the floor, to use idlers to loop it up as it were, thus forming a passageway at a point that would otherwise be obstructed. If a belt is overloaded, it is certainly poor engineering to force an idler hard down upon its back, and before such an extreme is resorted to it will surely be cheaper in the end to remodel the arrangement of the shafting, and place things in a more favorable position.

Twenty-two Inch Swing Engine Lathe.

We present with this the 22-inch screw-cutting engine lathe, built by Geo. D. Walcott & Son, Jackson, Mich. As represented by the engraving, the lathe appears to be heavy in construction and of pleasing design.

The live spindle is of hammered tool steel, the front bearing being 3″ diameter by 5½″ in length. The back bearing is 2″ diameter and 3″ long. The steps of cone pulley are 3¼″ face, the largest one being 12″ diameter. The tail-stock spindle is of steel, 2″ diameter, fitted to long bearings, the front one being split for clamping screw.

The lead screw, feed rod, studs, etc., are of steel. The rack is of steel, cut in one continuous piece. The apron, pinions, and other small gears are of steel, and all gears are cut from solid metal.

The lathe has automatic cross-feed, and is furnished with a large and small face-plate, a steady-rest, change gears for cutting threads from 2 to 22 to the inch; also countershaft and necessary wrenches. When desired, it is fitted with compound rest, and attachments for turning shafting; also taper attachment.

LETTERS FROM PRACTICAL MEN.

A Very Quick Return Planer.

Editor American Machinist:

In your notice of the quick return motion on the planer you saw in our shop, you neglected to say that the machine was not our make, and did not neglect to say that it was "somewhat noisy." Now, of course, this would give the impression—to those who know that we manufacture planers—that our planers are noisy. We wish to say that, while the machine you saw in use was a very good machine, it was made by a concern that has since gone out of business. At the time it was built a great many first-class tool builders put cast gearing on their planers. The writer got impatient at seeing the machine travel back at such a slow rate, so put on a backing pulley three times the size of the go-ahead pulley; this made the machine "somewhat noisy," which was an objection, but was more than counterbalanced by the comforting knowledge that we were getting out a great deal more work.

There are hundreds of old planers (and some new ones) in this country that might be speeded back in this simple way. The idea, of course, is not new, as almost all tool builders put on a quick return of some kind. All we did in doctoring this planer was in giving it a very large dose of a well-known remedy.

G. A. GRAY, JR., & CO.

Cincinnati, O.

A Heavy Job on a Light Lathe.

Editor American Machinist:

I tried a little kink in doing a heavy job on a light lathe, that may be of service to some one else similarly situated. I had occasion to bore out several hydraulic cylinders weighing 4,000 lbs. each. I had to do this on a lathe raised to swing 42″, the spindle being only 2½″ diameter. The spindle was altogether too light for such a job (16″ bore 28″ from face plate,) so I arranged two

rollers for the edge of the face plate to run on, and rigged a steady rest in front, and everything went smoothly, the rollers and steady rest carrying the weight, thus relieving the spindle. R. S.

Difficulties in Using Twist Drills.

Editor American Machinist:

I wish to get a little information from those of experience in such matters. I have used twist drills ever since their introduction, but whether in a drill press or lathe, find more or less trouble in sizes from ¾″ to 2″. They have a treacherous way of running out, even when started true, to their full size. I run fast in starting, but find it somewhat tedious to get them started right. I also find that the twist of the drill is likely to repeat itself in the hole, although I grind the drill carefully. In my opinion they are treacherous when more than ⅝″ in diameter. Perhaps some brother chip can set me right on some points in their use, and if so, I shall be pleased to have him do so. G. T.

[As a practical machinist our correspondent is entitled to be heard, and perhaps, as he suggests, some one may see a way to helping him. Our own experience is that the lips of a twist drill being usually of a more obtuse angle than an ordinary flat drill, it is not quite so easy to bring a hole to the line in starting, but that if properly ground and held, and if the work being drilled is stable, with no side twist brought on it by the operation of the drill, a very true hole can be drilled with them. Under these circumstances we have never experienced difficulty with the hole being rifled. Under contrary conditions to those enumerated we have seen twist drills operate as our correspondent specifies.]

Separator for Steam Boilers.

Editor American Machinist:

In one of the recent issues of the American Machinist a correspondent asks, "What is the best arrangement for taking water out of steam which has been carried a long distance?"

As this question is continually recurring, the arrangement of piping shown in the accompanying drawing may be of interest to your readers. It has been extensively used and found to answer the purpose in every respect, and can be made by any ordinary pipe-fitter.

The arrangement stands vertically, steam entering at the top *B*, of the space *A*, between the two pipes, at a tangent, the speed of the current setting up a centrifugal action, as it passes down between the two pipes in a spiral line and throwing the entrained water against the outside pipe *E*, whence it trickles down into the space below, the dry steam turning up and passing out through the center pipe, *D*, *C*. A trap may be connected at the bottom *F*, or, if preferable, it can be blown off by hand, when collected water shows in the glass gauge *G*, properly placed for that purpose. The inside pipe should be larger than the supply, so as to allow the current to slow down at the point where the steam turns to pass out, and thus avoid picking up any water which has already been separated from it. The end *D*, of the supply pipe, where the steam enters, should be flattened out, making the opening at least twice as long as it is broad. The space between the outside and inside tubes should not exceed the area of the supply pipe to any considerable extent, or else the speed of current will be so much lessened that the centrifugal action will not be sufficient to throw off the water. *I* represents a top view of the separator. Steam.

New York City.

Why Machinists Should be Inventors.

Editor American Machinist:

A few years ago I was looking over a city directory, and I found the name of a man that had given his business as an inventor. On inquiring further, I found that he had originated or stolen an idea of a potato digger, or something of that sort, and had sold his patent for a few hundred dollars. On the strength of that he had set up in business as an inventor, but I have never heard of his getting up anything since.

A few days ago I saw a man drilling a hole in the end of a shaft. After he had got to the depth of his twist drill, he found trouble to get oil to its point; so he got a piece of flat steel, made a drill on one end, took a piece of tin and formed a trough, which he soldered on one side, reaching from heel to point. The latter, of course, formed a pipe through which the water or oil would flow to the point of his drill. Then he got from the scrap-brass box an old student lamp receiver, to which he soldered near the bottom a short piece of pipe with a cock in it. Next, with a block of wood that would just fill the receiver for a plunger, he had a force pump that would not only lubricate the point of his drill, but would force the chips out. Then he was ready for business, and it was business in earnest. He has not set himself up for an inventor, although he showed more ingenuity than is seen in many of the patents of the present day.

An old farmer came to the shop where I was engaged. He thought he had made a wonderful invention, for which he had obtained a patent. He wanted a sample machine built. The catches, levers and springs were a wonder to behold, but we started under his instruction. After a little he found that one of his devices would not work as he had imagined it would, and began to inquire if we knew of anything that would do what he wanted. We suggested a way that he might try, although we were not sure that it would do. "Why, I supposed machinists had devices all ready for anything, and that would work every time without any mistake," said our customer.

We assured him that we were not quite so well loaded as that, particularly where it was to do what we had never seen done. Now, suppose he had tried our plan, and it had worked, while his own plan would not work, and so on with every device, through his machine, who would have been the inventor? The law would have sustained him as the inventor, but without the ideas of the machinist where would he have been?

The question naturally arises, Can a man be a good machinist if he is not an inventor? I should emphatically say "No," for I do not think that a man who can do work only as he has seen it done, and who cannot devise a way of his own to do it, will ever be the man to depend upon when you get in a tight place. H. Reynolds.

Ithaca, N. Y.

Hydrostatic Test for Boilers.

(From the "Locomotive.")

Several months ago we considered what the proper hydrostatic test pressure for new boilers should be, but the periodical application of the test to old boilers in active service was not discussed. Let us now very briefly review the subject. Many high authorities recommend the periodical application of the test to *all* boilers after they are put at work. With certain classes of boilers this is absolutely necessary, for their construction, location, and management will not admit of any other kind of inspection, if the mere application of the test can be called an inspection in any sense of the word. But for the proper application of the test pressure, to be of any value whatever, and to *insure no damage* to the boiler, it is necessary that the person making it shall have excellent judgment combined with considerable experience, and no small amount of mechanical skill. These qualities are rarely found, except in those who make boiler inspection a profession.

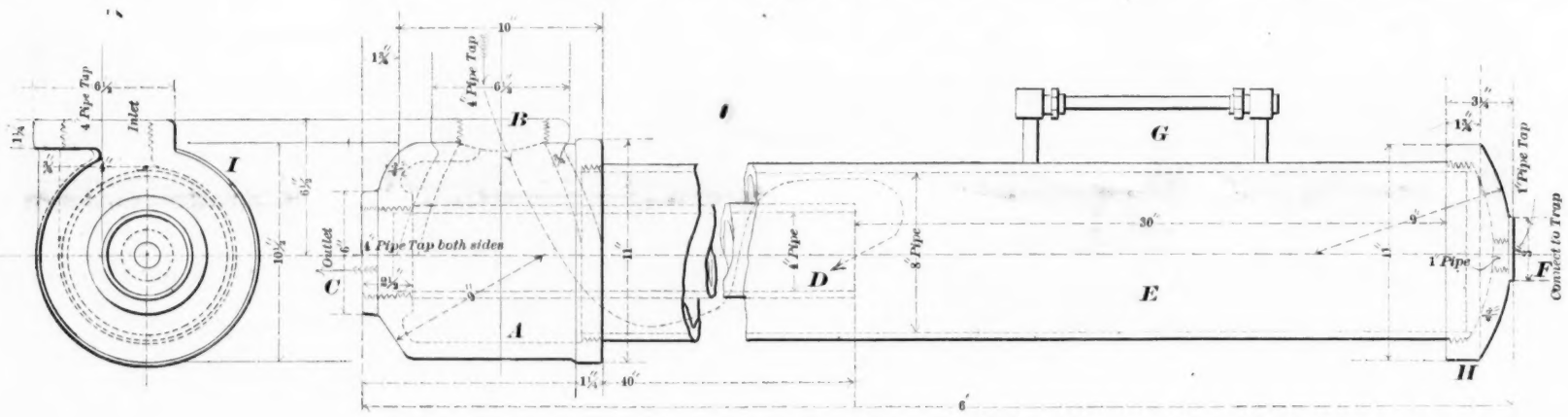
The hydrostatic test should always be applied to new boilers, and to old ones after any considerable repairs have been made. This is the only way by which the staunchness of joints and quality of riveting can be tested while the boiler is in position to allow of any repairs or further work to be done on it which may be necessary. Its value for this purpose cannot be overestimated, but the combined experience of all boiler inspection and insurance associations, both in this country and Europe, shows conclusively that, when a boiler properly designed so that a fairly complete internal and external examination can be made, has once satisfactorily withstood the hydrostatic test, and thus had the quality of its workmanship proved, is put into service, and does its work without showing distress or weakness, the periodical application of the hydrostatic test is wholly unnecessary, proves nothing, and reveals no defects. Of course it goes without saying that the boiler insurance companies are directly interested to a greater extent than any one else can possibly be, in ascertaining and adhering to the method of inspection which is *the most efficient*, and the fact that the above is the ground taken universally by them ought to settle the question beyond the possibility of dispute. Indeed, the application of the test according to the rules laid down by its most eminent advocates, is an absurdity. We are instructed by them to first make a careful internal and external examination to determine the proper working pressure, then apply the test.

Now it is evident that if the man who makes the inspection is competent to fix the proper pressure, the test is unnecessary; if he is *not* competent to do so, there is an even chance that he will allow too great a pressure, and the boiler may be subsequently injured by the excessive test pressure which he applies.

The hydrostatic test in itself, gives us no knowledge of the actual strength of a boiler unless we burst the boiler by means of it. It does not reveal the presence of scale, sediment, corrosion, burned and blistered plates, and the thousand and one things that are every day discovered by professional inspectors, who prefer to use their eyes instead of a pump, although the former involves much more hard and disagreeble labor. It may safely be asserted that ninety-nine per cent. of all explosions which occur are due to causes which the hydrostatic test would utterly fail to reveal, while the remaining one per cent. is due to some defect which would be more readily discovered in some other manner.

The fixing of a safe pressure for an old boiler is one of much difficulty sometimes, and can only be done by a man who has had a long experience, and a chance to watch the actual behavior of all kinds of boilers under varying conditions of use. It is something which from its very nature defies any attempt at calculation or to reduce it to a set rule or formula. It is amusing sometimes to see the confidence with which experts, so called, in giving testimony before coroners' juries will "figure out" the bursting pressure of a boiler, which perhaps they never saw, which might be in good condition, or might be corroded in places to the thinness of writing paper. All such attempts are sheer nonsense. The proper pressure can be estimated only by a man who has seen thousands of boilers, in every state of dilapidation, who has seen exploded boilers, investigated the causes of their failure, compared the nature and extent of these causes with other similar ones he has met with, and whose progress he may have been watching for years, and who is thus enabled to form an accurate opinion of the strength of any given boiler, whatever the nature or extent of its defects. This being the case, is it possible to suppose that the condition of boilers will be improved, or the safety of those employed in their vicinity will be assured, because some one, who may never have seen the interior of a boiler, has "pumped it up" to some excessive pressure and it "didn't bust?"

But let it not be judged from the foregoing that we are opposed to the proper use of the hydrostatic test. It is only its *abuse* that we object to, and the idea that it is the only way to ascertain the strength of a boiler. We reiterate that it should always be applied to new boilers, old ones extensively repaired, and all those which cannot be examined thoroughly inside and outside.



Separator for Steam Boilers.

The *Railway Age* gives the following as the estimated railway mileage of the world, January 1, 1883:

	Miles.
United States	113,000
Europe	109,000
Asia	8,000
South America	7,000
Canada	8,500
Australia	3,200
Africa	2,200
Mexico	2,100
Grand total	253,000

The light house to be constructed at Fourteen Foot Bank, Delaware Bay, it is said, will be the largest structure of the kind in the world. The point at which it is to be erected is twelve miles from the mainland, and the foundation will be laid in twenty-one feet of water.

"Moore County Grit" Portable Mill.

The engraving on this page represents a new portable grist mill, driven by a portable engine. This mill consists of a 36-inch "Moore County Grit," so called from the fact that the material of which the stones are composed is quarried in Moore County, N. C. The engine here shown is rated at 8-horse power, and of a strong, substantial make. The mill has a silent feed, exhaust fan, sifter, meal and bran box, as shown.

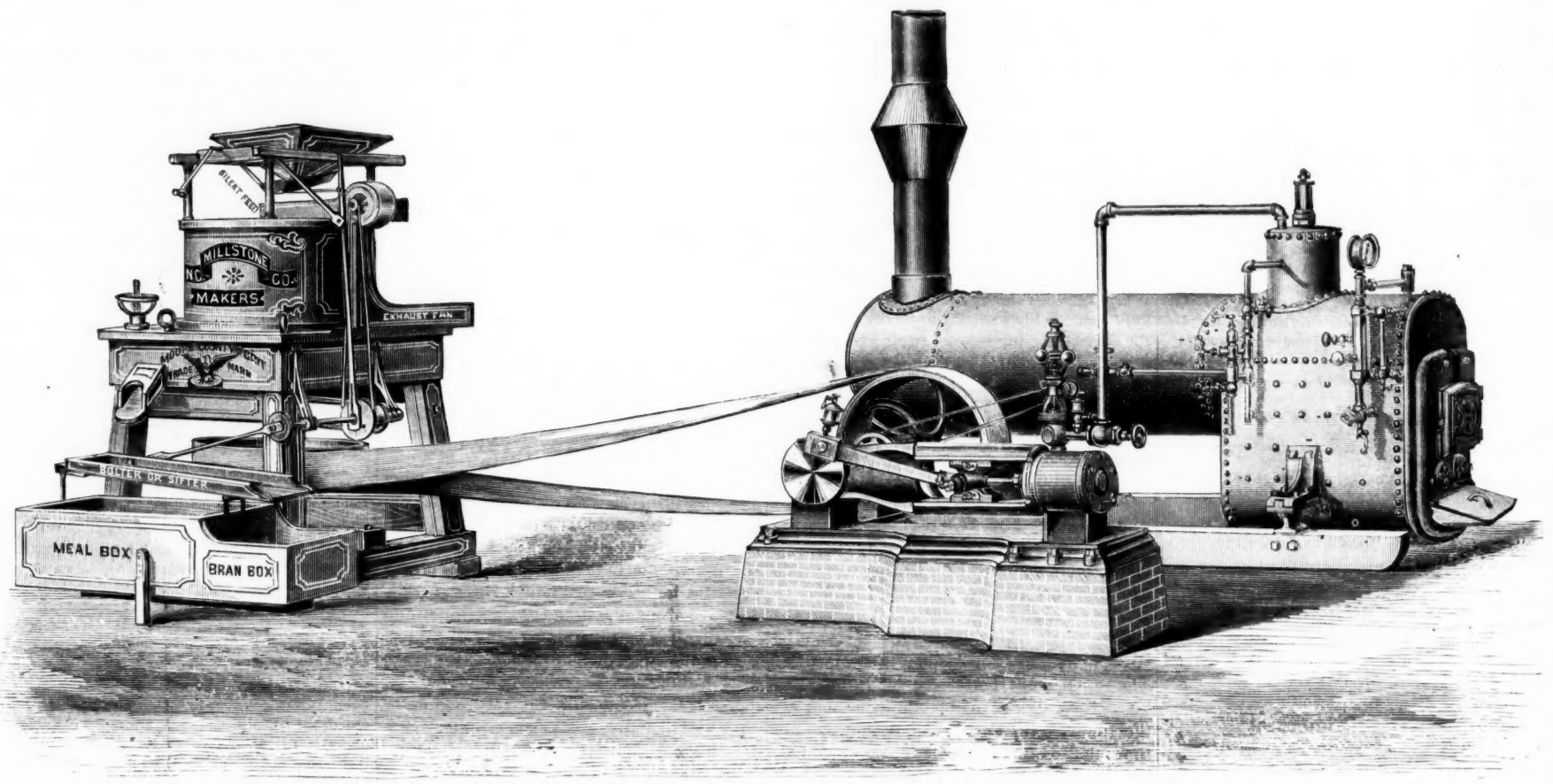
The "Moore County grit" is a peculiar formation of stone that is gaining a wide-spread reputation for grinding good table meal. The vein was first discovered nearly 100 years ago by the early settlers in Moore County, since which time it has had a good local reputation for the above purpose. Until lately the quarry has been a long distance from all railroad communication, and was never brought into prominence until the entire vein was purchased by the N. C. Millstone Company, Carthage, Moore County, N. C., who are now operating it with improved machinery, and are rapidly bringing its merits before the public. Already the company have developed a little village of workmen, and as a proposed railroad will shortly be built to their quarries, it cannot help but increase their present production.

The claims of this stone for grinding corn meal are, that it will not glaze, that it wears different from most other millstones, it having a tendency to wear sharp, instead of smooth, on its face. It is said to grind meal into round particles, and to raise the bulk of a bushel of corn, when ground into meal, from 30 to 40 per cent. The meal is understood to be light in weight, and not liable to be heavy when made into bread.

From the sharpness of the stone, it is claimed that less power is required to do the same amount of work than other millstones, that tend to glaze or wear smooth upon their surfaces.

The capacity of the mill here shown is claimed to be eight bushels of the best quality of table meal per hour. When mixed grain or chop is to be ground, the capacity can be increased to double the amount named above.

It will be observed that the claim for this mill is not the large quantity that can be forced through it, but for the quality of meal it produces with stones of unusually small diameter. This is a matter always important, and sometimes of much more importance than that of the quantity that can be ground with a mill.



Portable Corn Mill, Driven by a Taylor Engine.

Calculating the Pressure at Which a Safety Valve will Blow off Steam.

By William J. Williams.

In calculating the effect of a safety-valve lever and its attachments to hold the valve against the pressure operating to raise it, three quantities are to be considered. First, the action or effect of the weight on the lever. This varies according to its distance from the fulcrum. Second, the action of the lever itself, which is a constant quantity. Third, the influence of the valve and stem as a part of the force acting with the other two. This latter is also a constant quantity.

The first quantity can be found by multiplying the weight in pounds by its distance from the fulcrum, and dividing this product by the distance from the fulcrum to the valve (measuring from center to center). The second may be found by multiplying the distance from center of fulcrum to center of gravity of the lever by the weight of the lever, and dividing by the distance from center of fulcrum to center of valve. The third is as the weight of the valve and stem. To state these :

The first is,

$$\frac{\text{weight} \times \text{distance from fulcrum}}{\text{distance from fulcrum to valve}} = \text{effect of weight.}$$

The second,

$$\frac{\text{center of gravity of lever} \times \text{weight of lever}}{\text{distance from fulcrum to valve}} = \text{effect of lever.}$$

Assume the weight to be 20 lbs., the distance from fulcrum to weight to be 24", the distance from fulcrum to center of gravity of lever to be 12.125 inches, the weight of lever to be 1.8125 lbs., the weight of valve and stem to be 0.96875 lbs., and the area of valve 6". Fulcrum to valve 2". Then the effect of weight is,

$$\frac{20 \times 24}{2} = 240 \text{ lbs}$$; the effect of lever is,

$$\frac{12.125 \times 1.8125}{2} = 10.9882 \text{ lbs.};$$

and the weight of valve and stem, as has been seen, 0.96875 lbs. Adding these together and dividing by area of valve and

$$\frac{240 + 10.9882 + 0.96875}{6} = 41.99 \text{ lbs.}$$

as the pressure at which the valve will blow off.

Mr. Otto Arnold, a member of the firm of Schaffer & Budenberg, Buckau-Magdeburg, Germany, is in this country on business.

Wages of Shipbuilders.

There has been considerable talk in free trade and "revenue reform" circles about the high wages paid by iron shipbuilders on the Clyde as compared with wages paid by iron shipbuilders on the Delaware. At a recent meeting of the Brooklyn Revenue Reform Club, the editor of a prominent daily made the following assertion, according to the report in his own newspaper: "A shipbuilder recently attempted to get some riveters from the Clyde shipyards, but the men were unwilling to leave Glasgow, where they were receiving twenty-five dollars a week, to work in American yards at fifteen dollars." Statements of this kind are given wide circulation by those interested in breaking down our protective tariff, and as comparatively few readers of daily papers take pains to inquire closely into the truth of matters they see presented for facts and reiterated day after day, false ideas sometimes gain wide credence.

Edward Young, formerly Chief of the Bureau of Statistics at Washington, and who has positive knowledge of this matter, says:

"In 1872 I personally visited the iron shipbuilding yards on the Clyde and obtained from the books of the largest firm the rates and weekly wages actually paid. In 1874 the same firm gave me the rates then paid in their shipyard, from which it appears that the wages of 146 riveters average 27s. 10d., or $6.68 per week. As it was stated that there was a considerable advance in the rates of wages since 1874, I recently obtained the rates actually paid by the same firm, whose letter, dated near Glasgow, Nov. 14, 1882, now lies before me. The weekly wages of 3,946 men employed by them in 43 different branches average 26s. 3d., or $6.30, including 288 riveters whose pay was 29s. 3d., or *seven dollars and two cents* each, not $25 per week—a *slight* discrepancy of $17.98. It may be mentioned that in 1874 the men worked 51 hours per week, and 54 hours in 1882.

"In 1871 the weekly wages of riveters was from $5.08 to $5.32 in Glasgow, and in the Metropolitan district from $5.56 to $7.26, who worked 57 hours per week. In Belfast wages were $1.01 a day, or $6.06 per week; at Newcastle-on-Tyne, $1.17 a day; and at Dundee from $6.53 to $7.02 per week. In 38 towns of Great Britain the average rate was $7.48, the hours of work being 54. In 1873 the rates paid in four shipyards averaged $7.62. In October, 1874, the firm of Harlan & Wolff, of Belfast, builders of the White Star line, paid riveters $1.13 per day or $6.78 per week. In no shipbuilding yard of Great Britain, either in 1871, when wages were abnormally high, or in any year since, have riveters obtained *one-third* of the $25 per week, the sum named as the ruling rate in the yards on the Clyde.

New Standards of Railway Time.

A great source of annoyance to railroad travelers is the variance in standards of time upon which trains are run. There are 56 different standards of time used by railroads in this country. The remedy for this has been talked of for years, but until the General Time Convention met in St. Louis, April 11, no plan had been offered that met the approval of railroad managers. At that convention (30,000 miles of road being represented) the following resolutions were unanimously adopted:

Resolved, That this convention recommends the adoption of the following as the future standards for the use of the railway lines of the country:

I. That all roads now using Boston, New York, Philadelphia, Baltimore, Toronto, Hamilton, or Washington time as standard, based upon meridians east of those points, or adjacent thereto, shall be governed by the seventy-fifth meridian or Eastern time (four minutes slower than New York time). [Note.—This includes roads run by Portland, Providence, New London, Montreal, Albany, Richmond, and Charleston time in addition to those specifically named above.]

II. That all roads now using Columbus, Savannah, Atlanta, Cincinnati, Louisville, Indianapolis, Chicago, Jefferson City, St. Paul, or Kansas City time, or standards based upon meridians adjacent thereto, shall be run by the ninetieth meridian time, to be called Central time, one hour slower than Eastern time and nine minutes slower than Chicago time. [Note.—This includes roads run by Macon, Rome, Nashville, Selma, Mobile, St. Louis, Vicksburg, Dubuque, Minneapolis, St. Joseph, Galveston, Houston, and Omaha time, in addition to those named above; also, the Union Pacific to North Platte and Wallace, the Burlington and Missouri River to (about) Culbertson, the Atchison, Topeka and Santa Fe Railway to Coolidge, the Texas Pacific to Toyah, and the Galveston, Harrisburg and San Antonio to Del Rio.]

III. That west of the above named sections the roads shall be run by the one hundred and fifth and the one hundred and twentieth meridian times, respectively, two and three hours slower than Eastern time.

IV. That all changes from one hour standard to another shall be made at the termini of roads or at the ends of divisions.

The Southern Railway Time Convention also adopted the above resolutions unanimously at their meeting in New York City, April 18. These five standards of time are to be adopted and applied next fall, provided the managers of the roads agree, which is now considered almost certain. This plan will obviate the annoyances travelers have heretofore experienced, and is an improvement in railway management of no small importance.

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NEW YORK, MAY, 5, 1883.

CONTENTS.

	PAGE
Making Cylinders and Castings to Finish. By Thos. D. West	1
Method of Finding the Shape of Moulding Machine Cutters	2
Extracts from Chordal's Letters	3
Olsen's Improved Nut Tapper	4
Foundations for Stationary Engines	4
Inventing Things that are Not Needed—The Link Motion and How to Improve It. By J. Edson	4
Belts—Conditions Affecting Power Transmitted—Quarter-Turn—Idler Pulleys. By Charles A. Hague	5
Twenty-two Inch Swing Engine Lathe	5
Letters from Practical Men—A Very Quick Return Planer—A Heavy Job on a Light Lathe—Difficulties in Using Twist Drills—Separator for Steam Boilers—Why Machinists Should be Inventors	5, 6
Tests for Boilers	6
Moore County Grit Portable Mill	7
Calculating the Pressure at which a Safety Valve will blow off Steam	7
Wages of Shipbuilders	7
New Standards of Railway Time	7
Modern Machine Design	8
A Marked Feature of the Machine Business	8
Literary Notes	8
Questions and Answers	8
Business Specials	9
Manufactures	9
Machinists' and Engineers' Supplies	10
Iron and Metal Review	10

Modern Machine Design.

Economy of manufacture has assumed a prominence in machine design hardly thought of a few years ago. This is especially true in relation to standard machines, to be, presumably, manufactured in quantities, which makes a defect in this respect formidable by multiplication. Cheapness, in the sense of inferiority, receives but little consideration in machine design, but cheapness, in the sense of calling for the least labor in the workshop to produce the desired result, is indispensable. The older practice in machine design was, to a great extent, for the shopmen to adapt their ways to those of the draughtsman; the modern practice for the draughtsman to adapt his designs to the ways of those who deal with the actual materials of construction.

Economy in the use of material was, twenty years ago, by comparison, the great objective point in machine design, and the extent to which this was carried is yet manifest, and is bringing about a reaction likely to reach, in many instances, the opposite extreme; but, so far as reformation in design goes only in the direction of cheapening the cost of manufacture, there can be no extreme.

With cast iron entering so largely into machine construction, a few pounds more or less in weight is frequently of slight importance, in comparison with the labor of construction. It is a question of time when almost any conceiveable machine design can be reproduced in constructive materials, but this question of time is what has, more than anything else, to do with the value of the design. If the raw material of which a machine is made costs three cents, and the finished machine fifteen cents, per pound, manifestly the most promising point for reduction is the labor, by which the cost is increased twelve cents per pound. A small proportionate reduction in the item of greatest cost will balance a large one in the item of least cost.

Cheapening the cost of labor does not necessarily mean that fewer parts shall be subjected to machine processes, but more generally that the parts shall be so arranged as to be come at by the tools best suited to do the work quickly. It is not the amount of metal to be removed or the surface to be gone over that determines the time required to perform machine operations, so much as the facility with which these surfaces can be come at with tools best suited to the purpose. The actual work performed in drilling two holes, for instance, may be the same, and yet the time required to drill one may be ten times that required to drill the other. Modern machine design contemplates locating the hole where it can be drilled in five rather than in fifty minutes. Some machine processes are much more rapid than others, by which substantially identical results are reached. Modern machine design contemplates using the rapid processes. To do this requires a knowledge of machine processes, that gives the practical shopman an advantage hard to be overcome. Given the necessary knowledge to correctly proportion parts and bring about the end of correct operation, and there is still the necessity of seeing how the various parts are to get into and through the machine shop at the least cost—something that cannot be acquired outside the shop.

Theory may plan to resist strains and provide stability, but theory has little to do with machine processes. The absolute requirements of modern machine design open opportunities for shopmen—those who are willing to study hard for the necessary acquirements—that were hardly open in any sense twenty-five years ago. The modern machine designer must be familiar with modern shop processes, to a degree that will enable him to make these processes a part of his design—not something that must be worked in as a matter of future consideration, and at a cost not guaranteed by the results. Nothing short of this can keep pace with the spirit of competition, keenly alive to every advantage for reducing cost while maintaining the standard of excellence.

A Marked Feature of the Machine Business.

A marked feature of the machine business at the present time is the number of establishments, large and small, which are fitting up for the manufacture, as distinct from the building, of machinery. This tendency is not confined to any one branch, but is showing itself in machine tools, steam engines, machinery specialties and general machinery about equally. It is, after all, only in strict accordance with the principle which underlies all modern civilization, namely, the subdivision of labor, as applied, not merely to labor alone, but to capital as well. Just as occupations have gone on being divided and subdivided again and again, so in this country the time is approaching when builders of steam engines must prepare to meet the competition of manufacturers, except where special sizes or circumstances are concerned. In like manner, even a small shop, fitted up with special tools adapted to the systematic manufacture of perhaps two or three sizes of a single machine tool, may have, so far as those sizes are concerned, a marked advantage over even the largest establishments, prepared to build a multiplicity of tools in the old way, without specially devised facilities for the rapid and accurate manufacture of any. For many, this may not be an agreeable prospect to face, but it is usually better to take a front view than a rear view of such a situation.

The steam engine indicator continues to be the subject of considerable criticism, against which, however, it makes reasonable progress. If those who seek to discredit its teachings will tell us why, with the conditions of an engine, such as tightness of valves and piston known, and the quality of steam determined, the indicator diagram does not fairly show the character of that part of the engine to which it is applied, something will be added to the present knowledge of steam engineering. The standard fling about handsome cards so frequently used is meaningless. The æsthetics of an indicator diagram are not of much value from an engineering view; and if the end sought is a handsome outline, there are other means of producing it better than those offered by the use of the indicator. If it is expected that the indicator diagram is to show the first cost of plant and the price of fuel aud cost of attendance, it is a failure. When used to demonstrate how much the desired behavior of steam in the cylinder is influenced by peculiarities of construction, or when intelligently used to determine cylinder economy, and for various other purposes, it is a success, in the opinion of most engineers.

Literary Notes.

TWENTY YEARS WITH THE INDICATOR.—Thos. Pray, Jr., C. E., M. E., Consulting Engineer, Editor *Cotton, Wool and Iron*, etc. Volume I. Boston, Mass. Boston Journal of Commerce Publishing Company.

This book is mainly a revision of the articles on the use of the steam-engine indicator that have appeared in the publication of which the author is the editor. These articles are arranged in the form of "lessons," and possess the merit of being plainly written, with but little if anything in them that is beyond the comprehension of the student of ordinary ability. In fact, the evident intention of the author has been to prepare a book for plain, practical men, who care more for the facts than for the theories of steam engineering.

Previous to the commencement of the lessons, a chapter is devoted to the history of the indicator, the manner of attaching it to the cylinder, the computation of diagrams, and other matters directly or indirectly connected with its use. The first lesson explains a method of plotting the theoretical curve on the diagram, and is in part explanatory of the various lines made by the pencil of the instrument. Commencing with chapter 2, and continuing, the lessons are illustrated with diagrams, for the most part from actual practice, one of the most valuable features of the book being that examples of all sorts of diagrams—good, bad and indifferent—are given. Another feature that will be appreciated by the practical reader who is interested not only in the diagrams, but particularly in the machine from which they are taken—the steam engine—is that in many instances the steps taken to improve the working of the engine, and hence the character of the diagrams, are detailed and the result shown by introducing the diagrams taken before and after the alterations. The book concludes with a rule for setting eccentrics by measuring from the diagram, a rule for calorimeter test of steam, tables of the properties of steam, areas of circles, hyperbolic logarithms, expansion of steam, with other tables, rules and recipes useful to the operative engineer. The book (148 pages) is printed on sheets of sufficient size to present the diagrams of actual size, so that the student can trace and submit them to his own analysis. The price of the book is $1.50.

QUESTIONS & ANSWERS.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common sense methods.

(160) J. P., Trenton, N. J., asks: How can I cast or burn a neck on a broken roll? *A.*—See illustrated article on this subject in the AMERICAN MACHINIST of January 15, 1881.

(161) J. E. W., Wilmington, Del, asks: Where can I get information about making gear-wheels? *A.*—See articles by Prof. MacCord in AM. MACHINIST of August 7, 14 and 21, 1880.

(162) J. R., Montreal, Canada, who asks about the use of metal disks for cutting iron, is referred to answer to question 163 in the AMERICAN MACHINIST of May 13, 1882; also a communication on this subject in the issue of Jan. 13, 1883.

(163) F. H., New York, asks: Would it be as well to use two oscillating cylinders set at right angles on one crank for a small steam launch 15 to 20 feet long as to use stationary cylinders? *A.*—Our preference would be for the stationary cylinders.

(164) L. A. P., Nevada City, Cal., writes: I wish to test a water-wheel with a Prony brake, up to 100-horse power. The friction-wheel is 3 feet in diameter and will make 250 revolutions per minute. What distance from the center should the weight be? *A.*—With the common brake we should say not less than 15 feet.

(165) W. M., Newark, N. J., writes: I have a plunger pump 3″ diameter and 3″ stroke; speed, 125 revolutions per minute. The suction pipe is 2″ diameter, 85 feet long, the lift being 9 feet. The discharge is 1½″, 147 feet long and 25 feet high. All pipes are in good condition. The pump does not work. Would it be better to use smaller pipes? A.—No. If the suction pipe and the pump are tight, and the suction valve close to the pump, there should be no trouble. There is probably a leak somewhere.

(166) Apprentice, Boston, Mass., asks: Of what material shall I make a boiler for an engine of one-quarter horse power? *A.*—Copper is a good material for a small boiler. 2. How large should the cylinder be? *A.*—Make it 1½″x3″. 3. What should be the size of supply and exhaust pipe? *A.*—⅜′ supply; ½″ exhaust. 4. What packing shall I use? *A.* There are various kinds of fibrous packing sold by dealers that will answer your purpose. We do not recommend any special manufacture. 5. What kind of oil is used in small boilers? *A.* It is not customary to use oil in such boilers.

(167) M. D. S, Dubuque, Iowa, asks: 1. In laying up a boiler for the summer is it better to fill with water or to wash out and leave empty? *A.*—Opinions differ on this point. Our preference would be for washing out and thoroughly cleaning the boiler, then filling with water and adding from two quarts to a gallon of crude earth oil and getting up steam. When the steam is down, but the boiler not cold, let the water run out slowly; be sure the inside is quite dry and close all valves and hand holes. See that everything around the boiler is dry and that no moisture can get to the surfaces. 2. How large should the fire-box be for a boiler 3½ feet diameter, 3″ flues 7 feet long? The present fire-box is 3x5 feet? *A.*—You do not give the number of flues nor the kind of boiler, without which no answer can be given.

(168) R. J. S., Petersburg, Va., writes: In altering over an 11x20″ engine I found the pumps connected to the eccentric valve stem, and the valve with a travel of 4″. The valve is 6¾″ long,

with an exhaust pocket $3\frac{11}{16}$". The valve-seat is: Steam ports, $\frac{7}{8}$"; bridges, $1\frac{1}{8}$"; exhaust port, $1\frac{3}{4}$". I altered the travel of valve to $2\frac{3}{4}$". Do you think the engine bettered by the alteration, and if so, why? *A.*—It would not be possible to answer the question definitely without further particulars; such as length of ports and speed of engine. On general principles, not considering the pumps, $2\frac{3}{4}$" would be travel enough for a $\frac{7}{8}$" port and $\frac{1}{2}$" lap. With this reduced travel the expansion would be a little greater and the friction of the valve less. It would also give more compression, or if choked in the exhaust, the inside lap could be cut out and still preserve as much compression as with the 4" travel and $\frac{1}{8}$" inside lap.

(168) J. W. F. G., Grand Junction, Iowa, asks: Will you give me a rule for finding the weight of a fly-wheel suitable for an engine, when the size of cylinder and boiler pressure is known. We are building an engine 15"x24", plain slide valve. The valve has 1" outside lap, $3\frac{1}{2}$" inside lap, steam ports, 10"x1$\frac{1}{8}$"; exhaust port, 10"x2$\frac{1}{4}$"; travel of valve, $5\frac{1}{2}$". The diameter of fly-wheel is 90", and will make 70 revolutions per minute; boiler pressure, 75 lbs.? *A.*—A rule that will give good results, under ordinary circumstances, for a plain slide valve engine is: Divide 5,500,000 by the square of the number of revolutions per minute and by the diameter of the wheel in feet, the quotient will be the number of pounds the rim of the wheel should weigh for each horse power developed in the engine. Applying this to the example given, and

$$\frac{5{,}500{,}000}{70^2 \times 7.5} = 149.$$

Assuming the horse power of the engine to be 50, the weight of the rim of fly-wheel would be 149×50 =7,450 lbs. A wheel larger in diameter, or more revolutions per minute, would reduce the weight required. Wheels much lighter than this are frequently used, but the regulation is not so good.

(169) U. B., Chicago, Ill., asks: 1. In order to get the greatest power from a worm-wheel and endless screw, what should be the proportion between the size of the two? *A.*—In order to determine this exactly the quality of material, pressure, speed, and probably other conditions must be known. It is sufficient for ordinary purposes to consider that increasing the size of the worm reduces the angle of the screw and teeth, and hence reduces the power lost in end thrust. 2. Suppose a worm-wheel is $14\frac{1}{2}$" diameter and the worm $2\frac{1}{2}$", $\frac{1}{2}$" pitch, turned by a winch 18" long, lifting a weight of 2,500 lbs by a chain winding up on a 5" axle. Now as a screw is simply an inclined plane, suppose we keep the same pitch but increase the diameter to 3.7 inches the incline will be less, and will there not be a gain in power? *A.*—Aside from the question of friction there will be no gain. One revolution of the winch will raise the weight through the same distance, no matter what the diameter of the worm may be. There will undoubtedly be less friction with the larger wheel, and hence a gain in this way. 3. The friction is so great with the worm $\frac{1}{2}$" pitch as to cut the worm. Would there not be a gain in making the wheel $\frac{3}{4}$" pitch, and increasing the diameter so as to have the same number of teeth? *A.*—Yes; if at the same time the diameter of the worm is increased so that the angle is no greater than at present. If the diameter of the worm is still further increased, the friction will be still less.

(170) G. A. B., Kansas City, Mo., writes: I am running a 12"×24" engine 112 revolutions per minute, doing about 10-horse power work. I run with 40 lbs. steam pressure. The engine is fitted with a riding cut-off. The engine runs noisily. The main valve has $\frac{3}{8}$ steam lap, exhaust line and line; valve travel 2". Any change to more or less lead does not help the matter, and cutting off long or short makes no difference. I want to ask: 1. Is the valve proportioned right? *A.*—The proportions of the valve are those very commonly used with a riding cut-off. Such valves sometimes give trouble from not bringing about sufficient compression to arrest the momentum of the parts gradually. This can be remedied to some extent by adding inside lap, but this will cause back pressure, which represents a loss. We believe it better in the case of engines running more than 100 revolutions to give the main valve sufficient lap to cut off not later than $\frac{3}{4}$ stroke. By this means sufficient compression can be had to assist in accomplishing smooth running. Your engine is underloaded, and under the circumstances it would probably be an improvement to reduce the speed one-third. Still, if in line, and properly constructed, you should be able to run smoothly under the conditions named. 2. In cutting off at 7" is not the steam expanded below the atmosphere, and does not the partial vacuum cause the engine to pound? *A.*—Neglecting clearance, steam of 40 lbs. gauge pressure would be expanded below the atmosphere, which will sometimes cause pounding. This is generally more noticeable in the case of an upright engine, and we do not think it is the cause of your trouble. It looks more as if the difficulty was a mechanical one. Suppose, for experiment, you try the engine without cutting off at all. 3. Should a riding cut-off valve be equal to, greater, or less, in length than the distance between the ports of the main slide? *A.*—It may be either, depending on other conditions. 4. Can you give me a rule by which to determine the travel, length, &c., of a cut-off valve? *A.*—This information cannot be given in the form of a rule. 5. Does a rocking valve run with less friction than a flat slide valve, the exposed surface being equal? *A.*—We do not know that experiments have been made to determine this.

BUSINESS SPECIALS.

Transient Advertisements, 50 cts. a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Presses & Dies. Ferracute Mach. Co., Bridgeton, N.J

Steel Name Stamps, &c. J. B. Roney, Lynn, Mass.

Portable Forges, $10. Holt M'f'g Co., Cleveland, O.

James W. See, Consulting Engineer, Hamilton, O.

Lyman's Gear Chart. How to lay out gear teeth. Price 50 cents. E. Lyman, C. E., New Haven, Conn.

Latest and best books on Steam Engineering. Send stamp for Catalogue. F. Keppy, Bridgeport, Ct.

In stock.—16" speed lathes of superior design, from new patterns.—Fay & Scott, Dexter, Me.

Consulting Engineer and Mechanical expert, C. C. Hill, 144 LaSalle street, Chicago, Ill.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Wood Engraving done in best manner. Designs furnished. Edward Sears, 48 Beekman St. New York

Foot Power Machinery, for workshop use, sent on trial if desired. W.F. & John Barnes, Rockford, Ill.

Pattern and Brand Letters. Vanderburgh, Wells & Co., corner Fulton and Dutch streets, New York.

For sale, 25" lathes of best designs from new patterns. George A. Ohl & Co., E. Newark, N. J.

Chas. T. Porter, Mechanical Engineer, Tribune Building, (Room 42,) New York City.

Send description and prices of 14x20" and 16x24" engines and 5 x 12, 14 and 16 feet tubular boilers to Newell, Sanders & Co., Chattanooga, Tenn.

H. E. Penney, manufacturer of Steel Spring Cushioned Helve Hammers. Photo and circular on application. Minneapolis, Minn.

New tool chest, price $10. See description in AM. MACHINIST, April 14th, or send for circular. Goodnow & Wightman, 176 Wash'ton st, Boston, Mass.

Guild & Garrison's Steam Pump Works, Brooklyn, N. Y. Steam Pumping Machinery of every description. Send for catalogue.

Boiler Scale.—Parties having fine specimens for sale or loan, for exhibition, address Jas. F. Hotchkiss, 84 John street, New York.

How to reach 40,000 prominent "*Steam Users*" in the United States. Send for our circular. The J. N. Mills Publishing Company, 145 Broadway N. Y.

The Complete Practical Machinist, $2 50; the Pattern Maker's Assistant, $2.50; Mechanical Drawing Self-taught, $4 00; books for practical machinists. Address, Joshua Rose, Box 3,306, New York City.

Correction.—By a clerical error in advertisement of Money Saver, 95 Liberty street, New York, in last two issues of this paper postage for monthly journal to be sent free to engineers and mechanics was stated 12 6-cent stamps. It should read 12 one-cent stamps. Send to above address.

"Patent Binder" for the AMERICAN MACHINIST holds 52 weekly issues in good shape. Sent to any address by mail for one dollar. American Machinist Publishing Co., 96 Fulton street, New York.

Free—"Useful Hints on Steam." A book of 96 pages, illustrated. Valuable to engineers, steam users and those about purchasing steam machinery By mail, 15 cents, or free on personal application. E. E. Roberts, 107 Liberty St., New York City.

Wanted—Correspondence with engine builders, boiler makers, and supply dealers in steam goods. We manufacture the *cheapest* Injectors and best Steam Jet Pumps in this country, and offer to *live men* the most liberal terms ever named. Drop postal for particulars to J. B. Sheriff, Son & Co., 68 Water St., Pittsburg, Pa.

Now ready for delivery, volume 5 of the AMERICAN MACHINIST, comprising the year 1882, (52 issues) complete with index, in substantial book form Also a few remaining of volumes 3 and 4 comprising the years 1880 and 1881, can be sent anywhere by express. Price of each volume, $4.00; express charges to follow. AMERICAN MACHINIST Publishing Company, 96 Fulton street, New York City.

For a strictly first-class automatic engine, from 10 to 60 horse-power apply to the Straight Line Engine Company, Syracuse, N. Y.; medium or high-speed; perfect balance; fewest parts and fewest working joints; uniform speed at all ranges of power or steam pressure; the best material and workmanship in all vital parts; the most correct distribution of iron; unexcelled in smooth running.

Chordal's Letters.—John Wiley & Sons, 15 Astor Place, New York, have now ready a new and enlarged edition, with six additional plates, of Chordal's Letters, comprising the choicest selections from the series of articles entitled "Extracts from Chordal's Letters," which have appeared in the columns of the AMERICAN MACHINIST; with a steel portrait of the author, and upwards of fifty original illustrations by Chas. J. Taylor. One volume 12 mo. of nearly 400 pages, cloth, $2.00. Will be mailed and prepaid on the receipt of the price.

MANUFACTURES.

The B. W. Hoyt Company of Epping, N. H, will soon add another wing to their factory.

Joseph B. Reed, Cairo, Ill., is about to put in new machinery to increase his output of lathes.

John Breman & Co., Detroit, Mich., have bought a $2,000 lot in Battle Creek for the erection of boiler shops.

J. Duckworth, Springfield, Mass., is about to start the manufacture of bolts. He will also do machine jobbing.

The Florence Manufacturing Company, Northampton, Mass., are about to erect a new brick shop 43x100 feet.

L. Upham & Co., Pawtucket, R. I., have introduced and are manufacturing a new tool-chest for machinists.

A. Standish, Columbus, Ohio, reports business on his new foot-power hammer as increasing rapidly, and is behind his orders.

The Pulsometer Steam Pump Company, 38 John street, New York, have just issued a reduced price list of the New Pulsometer.

The Evansville (Ill.) Manufacturing Company, with a capital of $25,000, has been organized to make tacks and small nails.

The Union Foundry Company of Cleveland, Ohio, will remove to Detroit as soon as they get off some unfinished work now in hand.

W. P. Davis, North Bloomfield, N. Y., has issued an illustrated catalogue of his upright drill presses, key seaters and special machinery of improved designs.

The town of Dedham, Me., at the recent election, voted to exempt from taxation, for ten years, all investments to the amount of $10,000 in a woolen mill.

A company has been formed in Louisville, Ky. with $1,000,000 capital stock to manufacture automatic train signals, invented and patented by W. W. LeGrande.

The Manton Windlass and Steam Steerer Co., Mansfield, Mass., have moved into new shops built to manufacture steam steering apparatus for vessels, also hoisting machinery.

The Gloucester Iron Works, Gloucester City, N. J., are to be enlarged by the construction of a new foundry, 50x130 feet in dimensions, a step rendered necessary by increased work.

A large oil refinery is contemplated for Augusta, Ga. The capital necessary is already subscribed. It will be under the superintendence of Mr. T. Hill, who is one of the incorporators.

The new large harvester works at Winona, Minn., will have a capital of $250,000. The works, it is said, will be in charge of one of the most experienced and successful harvester men in this country.

The Hercules Iron works, Chicago, Ill., have just completed arrangements with Julius Hornig, of Jersey City, N. J., for the manufacture of his patent shears, punches and straightening machines.

The Georgia Central Railroad is to build at Macon, this season, several locomotives both for passenger and freight traffic. T. F. Warwick, draughtsman of the road, is preparing the drawings and specifications.

The E. T. Barnum Wire and Iron Works of Detroit, Mich., expect by May 1st to occupy their new factory, a large structure, 400x103 feet in dimensions and four stories in height. They are now employing 400 men, but will soon increase this force to 600.

About $100,000 has been subscribed for the cotton mill to be established at Newberry, S. C., and Col. Robert L. McLaughlin and Geo. S. Mower, of that city, are now in the North consulting mill engineers and machinery makers, and also looking out for more capital.

The Anglo-Swiss Condensed Milk Company., P. O. Box 3773, New York City, are about to erect a large factory at Middletown, N. Y. D. S. Page is general manager. The shafting has been ordered of George V. Cresson, Philadelphia. This company has immense factories in Europe.

Grading the ground for the location of the new shops of the Pennsylvania Company at Ft. Wayne, Ind., has been going on regardless of bad weather. The buildings will be of brick and quite extensive, for they will be large enough to afford employment for 1,000 men.—*Railway Age.*

Dwight Slate, Hartford, Conn., writes us: "I am running full on drills, milling machines, and on several contracts for special machinery. Business does not slack up with me. My cutting-off tools have taken a new start, and I cannot keep up with my orders for them, although I have increased my facilities for manufacturing."

George D. Walcott & Son, Jackson, Mich., build 22" engine lathes and 22" and 24" shapers as specialties. They have put out quite a number of tools within the last two years, considering the fact that their shop is not a large one. They have not been able to fill all orders on time until within the last two months, and now have not a tool ahead.

Kirk & Merrick, Oswego, N. Y., issue a new circular of Kirk's Compound Flux for iron founders in which they announce that they have fully overcome its tendency to chemically combine and solidify in warm weather and to evaporate when exposed to the atmosphere. The circular will be mailed to any foundry on applica ion.

The Melvin compound high speed steam engine now being introduced by James Beggs & Co., No. 9 Dey street, New York, is made in three classes, namely, A, B and C. The first class is a compound with steam jacket, the second is a compound without steam jacket, and the third a high pressure, using high pressure steam on both sides of the piston.

The S. Blackinton Woolen Company, North Adams, make fancy cassimeres, having 18 sets of cards, 30 broad and 56 narrow. They are making several changes, and will build a new boiler-house and chimney. They will reset one old boiler and have ordered three steel boilers of D. M. Dillon, Fitchburg, Mass. They will all be set with the Jarvis furnace.

Berton & Nickel, agents of the Jarvis Furnace Company, 422 East Twenty-third street, New York set for C. L. Weston, steam power, No. 332 Seventh avenue, about two weeks ago, one horizontal tubular boiler—6x16"—upon the Jarvis plan. The result being so satisfactory they were ordered to reset the other boiler, same size as above, without any hesitation, upon the Jarvis plan.

The Cummer Engine Company employs about 175 men, and will gradually increase its force to 300 men, the full capacity of its present plant. The factory, when completed and equipped, will consist of two moulding-rooms, 300x80 feet, and a machine shop 400x60 feet, two stories. Altogether the buildings and grounds will be 400x350 feet, and accommodate 500 workmen.—*Cleveland Trade Review.*

L. B. Eaton, formerly in the machinists' supply and tool trade at 11 North Sixth street, Philadelphia, has associated himself with J. F. Rogers & Co., mill, machinists' and engineers' supplies of New York City, and has opened a branch house in Philadelphia at 42 North Sixth street, where a full line of iron and wood working machinery, steam engines, feed water heaters, small tools and general shop supplies will be carried.

The Duggan-Parker Hardware Manufacturing Co. are running their new works full handed, with 160 men on the pay-roll. They have recently put in a good deal of new machinery in addition to what they contracted for and put in prior to starting their works. They are now very busy, and propose to make room for an additional foundry for making brass castings, which they have heretofore purchased from brass foundries as needed.—*St. Louis Age of Steel.*

Lowe & Watson, Bridgeport, Conn., have just received from John G. Borden, of the New York Condensed Milk Company, for their condensing works at Walden, N. Y., an order for two 80 H. P. Lowe boilers, making a total of 29 Lowe boilers which this company have had during the past 15 years. The Wheeler & Wilson Sewing Machine Company have ordered 15 Lowe boilers during the same time, while Sargent & Co., of New Haven, have 14 now in use.

Warner & Swasey, Cleveland, O., have sold 75 of their Monitor Lathes—of the kind illustrated in our last issue. They have been introduced into the leading brass manufactories throughout the country. The special chucks and fixtures to use in this machine are of great variety, limited only to the uses to which the machine is applied. Every part of a globe valve can be made on the machine without removing from the chuck.

Mr. Fieldhouse, the veteran pipe-maker of the firm of Fieldhouse, Dutcher & Belden, succeeded last week in drawing pipe from Bessemer steel plates—the first time in the history of pipe-making that steel has thus been welded. He is confident that on their new and improved furnaces at South Chicago he can weld all sizes. The importance of this improvement will be quickly seen. As soon as the necessary rolls can be put in by the manufacturers of the steel skelp (the North Chicago Rolling Mill Co.) Messrs. Fieldhouse, Dutcher & Belden will be able to make the pipe.—*Chicago Industrial World.*

A Connecticut machinery manufacturer writes us: "F. Deming, of Waterbury, has his new shop about finished, and will get into it in a month's time. He will employ quite a number of hands. Just what he is to manufacture I cannot say, but machinists and blacksmiths will be employed. The White Machine Company of Waterbury, have just put in a new Bigelow engine and boiler, starting up this morning. They have doubled their floor space, and also number of machines. They have just completed a very novel machine for the manipulation of scrap tin, and have several special machines in hand. I have a letter from my friend, Mr. Darling, of Pratt & Letchworth, Buffalo, N. Y., who tells me they are very busy in their steel-casting works, and are making quite a number of castings for use on the Panama Canal dredges. The articles are racks and pinions."

Crocker, Pell & Boardman, who started a new enterprise in the machine and foundry business at Minneapolis a little more than a year ago write us: "We are settling down solidly into our second business year. We have been filled to our utmost capacity for some time past with saw-mill and general machine work. We are at present building on orders one gang saw-mill from our improved design, two four-saw edgers, two sets of Parkhurst head-blocks and set works with carriages complete, three iron-frame log jacks, several batteries of saw-mill boiler fronts, and a good deal of general work. We are now shipping three elevator engines from entirely new patterns, with the elevator machinery complete; also the machinery for a 400 barrel flour mill. Everything looks favorable for the future."

The projected shops and freight yards of the New York, Lake Shore and Buffalo Railroad Company at East Frankfort, N. Y., will cover between 150 and 200 acres of ground on both sides of the tracks in East Frankfort, which is between Ilion and Frankfort, and within nine miles of Utica. The freight yard will have space for 25,000 cars and engines. The first building on the east will be the blacksmith shop, 300x70 feet; next, the boiler-house, 70x35 feet; next, the boiler shops, 312x70 feet; the capenter and pattern shop, 200x50 feet; the pattern storehouse, 50x40 feet; the foundry, 300x70 feet; the machine and erecting shops, 319x110 feet, and last of the principal buildings, the office of the company and drafting apartments, in a building 150x45 feet. The paint shops and other buildings, are nine or ten in number. The total length of these shops as planned thus far will be nearly half a mile; 1,000 men will be employed, and the shops are expected to cost $250,000.

Machinists' and Engineers' Supplies.

New York, April 19, 1883.

Numerous small orders continue to come in for goods and supplies for use at once.

There is a pretty general opinion existing among the dealers that prices are likely to drop a little in the near future, and hence they are careful in preventing the accumulation of much stock.

Iron and Metal Review.

The condition of the Pig Iron market does not improve. The stopping of several leading mills with the prospect of labor difficulties all tend to aggravate the situation. We quote prices as follows: Foundry, No. 1, at $23.50 to $24; Foundry, No. 2 X, $21.50 to $22; Grey Forge, $18 to $19.50. Foreign iron continues dull with a stolid indifference on the part of buyers. We quote: Glengarnock at $22 to $22.50; Coltness, $24 to $24.50; Gartsherrie, $24 to $24.50; Summerlee, $24 to $24.50; Carnbroe, $22; Eglinton, $21 to $21.50; Langloan, $24 to $24.50; Dalmellington, $21.75 to $22. Wrought Iron Scrap is rather slow at $26; prime, selected from yard; none offered from ship. There have been but few small orders for rails given since our last issue. Copper is in light demand at 15¾c. to 15⅞c. Banca Tin, 22c. Straits and Malacca, 21⅛c. to 21¼c. Australian, 21¾c. to 21⅝c. Spelter, Common Domestic, 4.75c. to 4.85c. Refined, 8c. to 8¼c. Lead, 4.40c. to 4.50c. Antimony, Hallett's, 9¾c. to 9⅞c.; Cookson's, 10¾c. to 10⅞c.

WANTED

"Situation and Help" Advertisements, 30 cents for each seven words (one line) each insertion. Copy should be sent to reach us not later than Thursday morning for the ensuing week's issue.

Wanted—Position by a stationary engineer accustomed to tools and can furnish the best of recommendations. Address Engineer, Lock Box 41, Waterville, Me.

Wanted—Ten machinists familiar with work on mowers and reapers; good wages and steady work for the right sort of men. Address "Mower and Reaper," care of Am. Machinist.

A prepossessing youth of noble mien, affable manner and smooth of tongue, wishes position as traveling salesman for some good machinery house. Address E. O., care Am. Machinist.

Situation wanted as foreman by middle-aged man who has had charge of works employing 200 or more men building engines of all kinds and general machinery; has been with one firm as such for 12 years; can give good reference. Address E. W. care of Am. Machinist.

Wanted—Position as superintendent or manager of a first-class machine shop in or near New York by an experienced mechanic, skilled in designing and construction; also familiar with foundry work; best references. A. B. C., 705 Summit avenue, Jersey City, N. J.

Wanted—By one of the best established machinery and supply houses in New York City, a man as mechanical engineer and salesman. Must be a practical millwright and draughtsman, posted on steam engines and appliances, machine tools, &c. One lacking any of these qualifications will not answer. Address, with reference as to character, habits and qualification, X, care American Machinist.

Wanted—A permanent position as general manager, superintendent or designer and draughtsman by a live, scientific and practical man of long experience in designing and draughting all kinds of new machinery, including engines and boilers, and in the general organization, system and discipline of the work shop and the management of the help; can furnish the best of references. Address A B. C., corner East Ninth and Oneida streets, old No. 87, Oswego, N. Y.

Light and fine interchangeable machinery to order. Foot and power lathes; slide rests, &c. Catalogue for stamp. Edwd O. Chase, Newark, N. J.

Wanted—Partner with capital for a valuable mechanical invention. Address "Inventor," care Am. Machinist.

For Sale Cheap—Machinists', Foundry and Boiler Tools, now in use, with or without shop. John Cathcart, Waterloo, N. Y.

Wanted—A Hydraulic Press of from 50 to 100 tons' pressure; one that works quick for pressing small articles. Address Dexter Curtis, Madison, Wis.

For Sale—Machine shop in a thriving town in Iowa with excellent trade and can be increased; good opening; cash required, about $5,000. Address Machine Shop, Am. Machinist.

BOOKS —RELATING TO— Steam Engines, Machinery, Heat, Gas, Electricity, Casting and Founding, &c.

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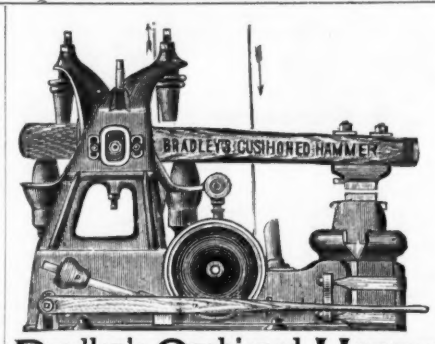

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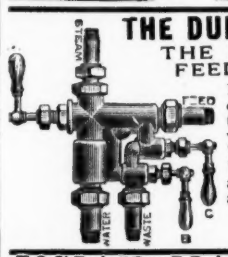

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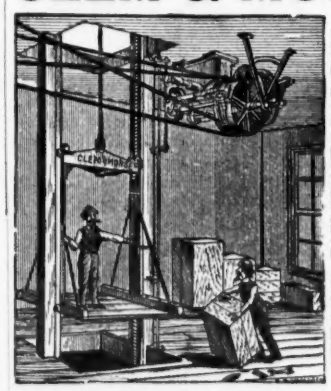

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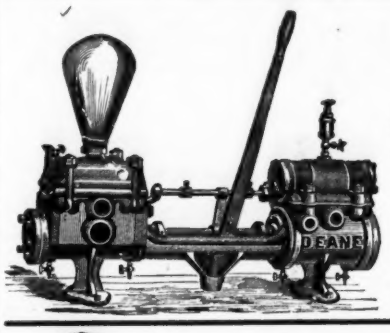

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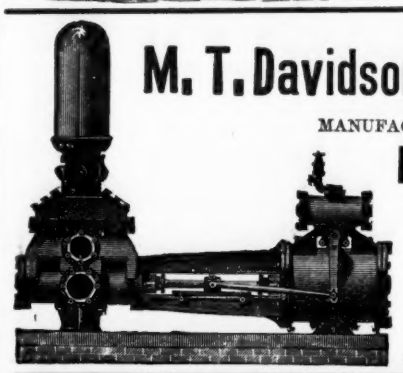

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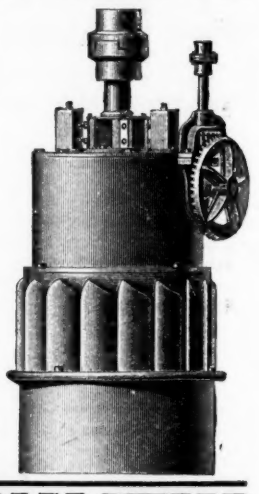

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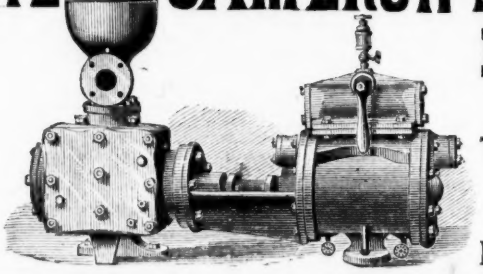

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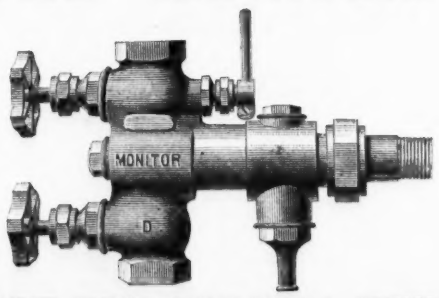

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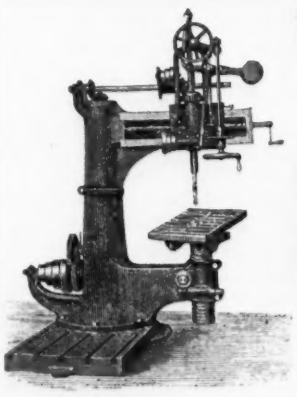

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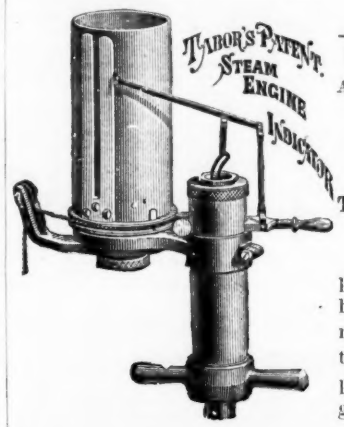

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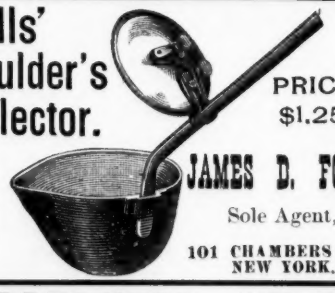

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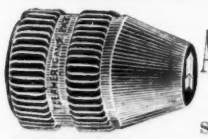

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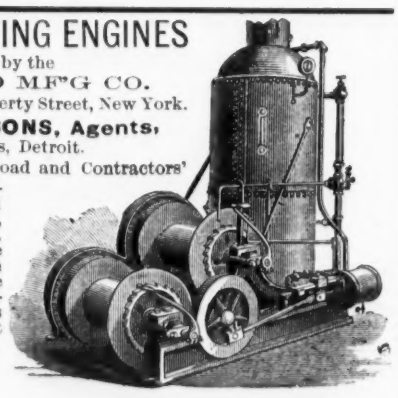

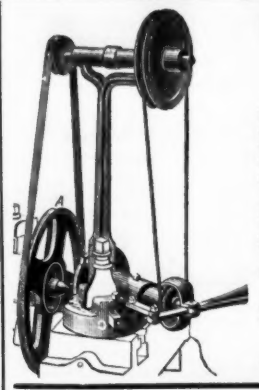

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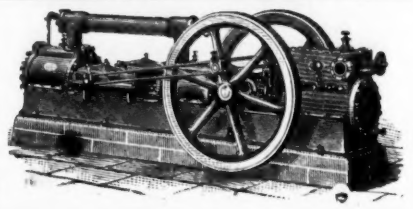

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" 10	1 1-2 "	1.10
" 11	1 3-4 "	1.25
" 12	2 "	1.40
" 13	2 1-4 "	1.60
" 14	2 1-2 "	1.60
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" 16	3 1-2 "	2.00
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Full set, 19 Dogs, 26.35

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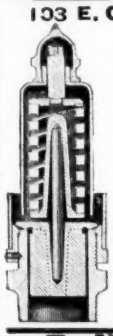

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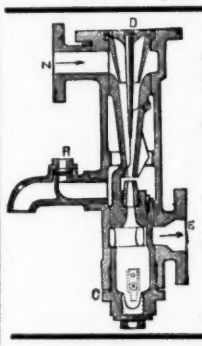

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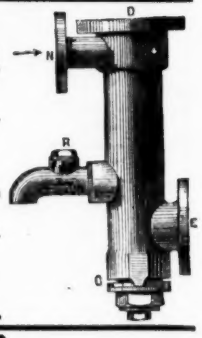

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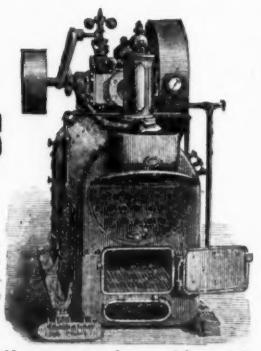

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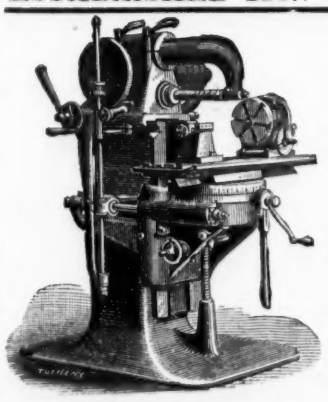

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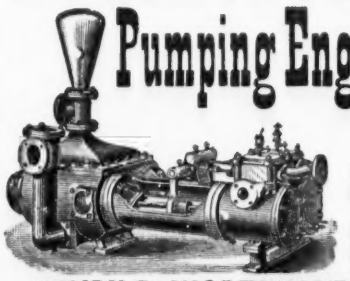

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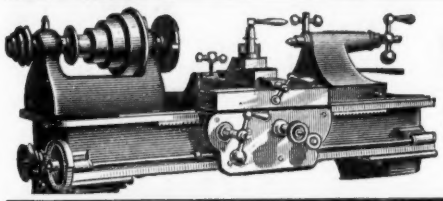

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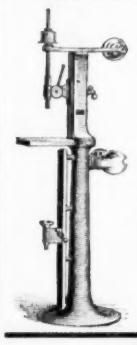

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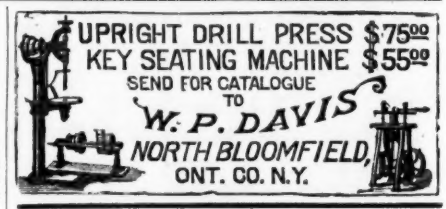

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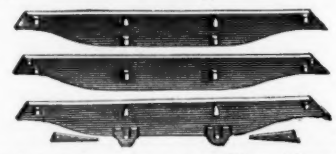

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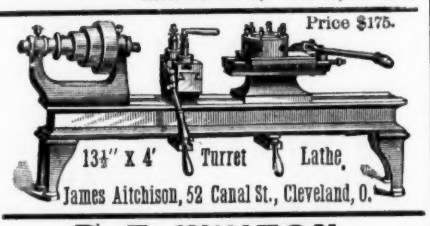

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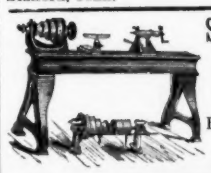

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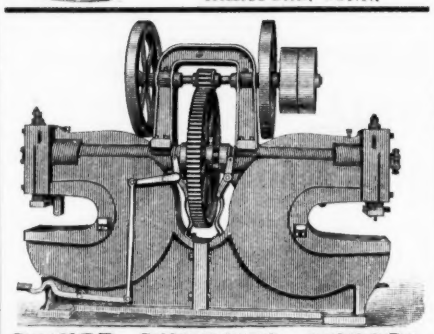

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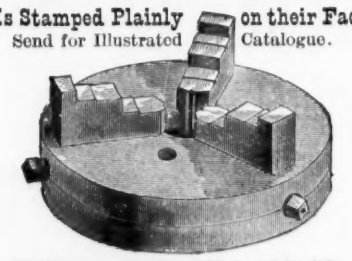

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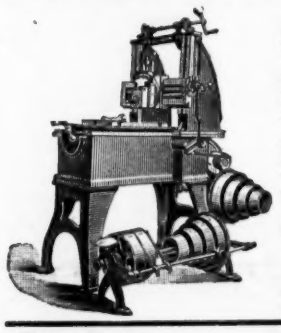

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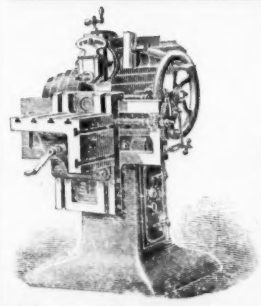

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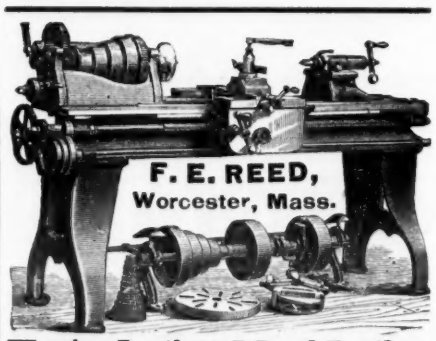

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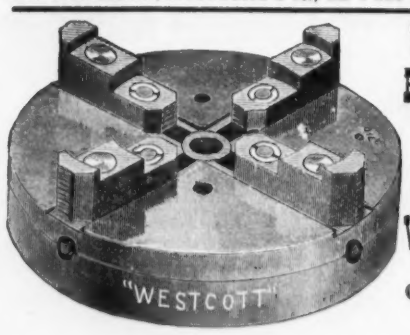

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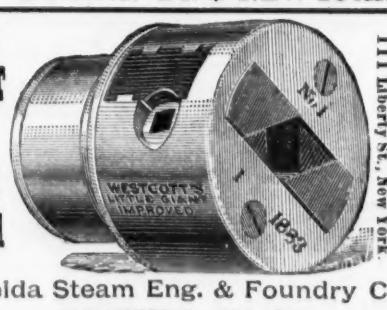

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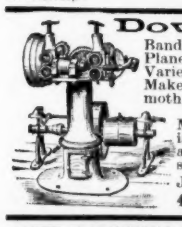

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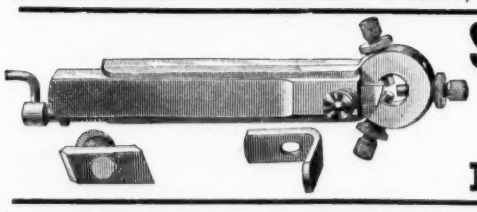

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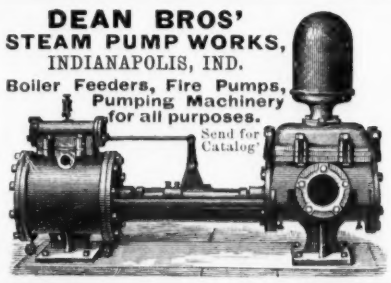

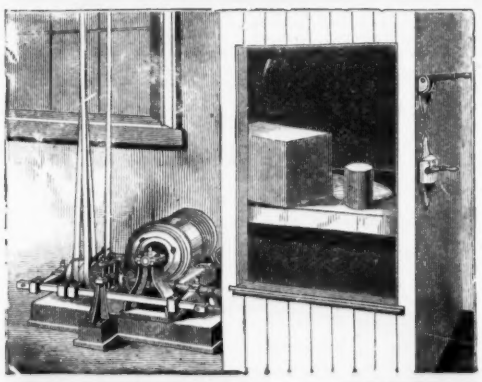

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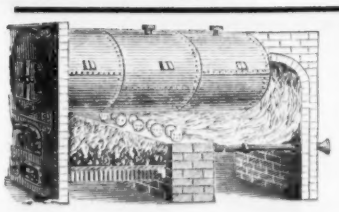

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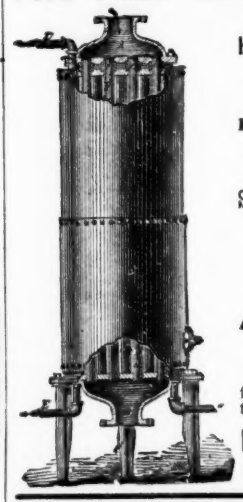

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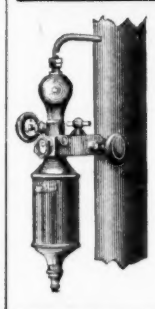

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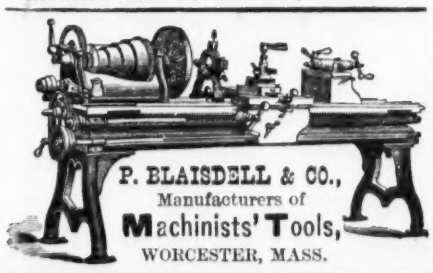

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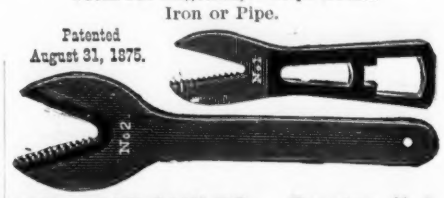

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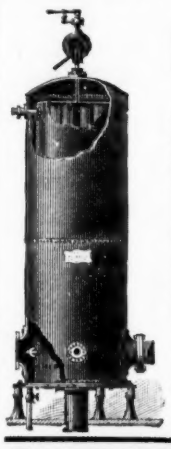

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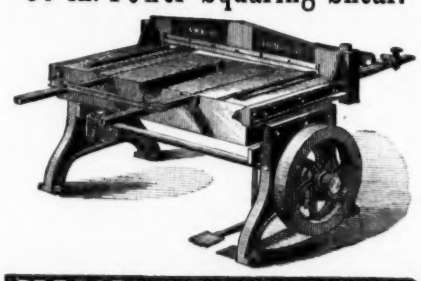

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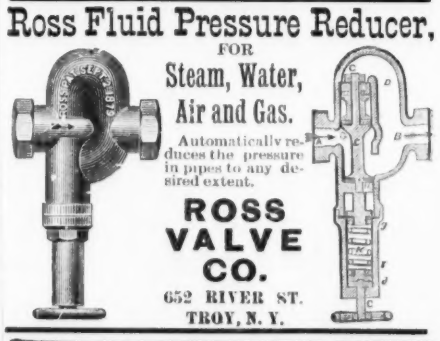

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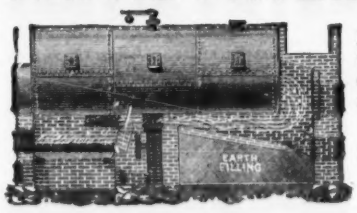

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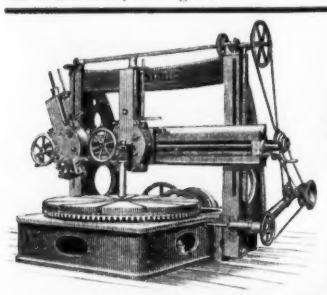

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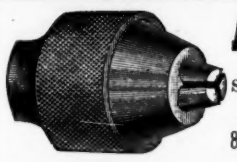

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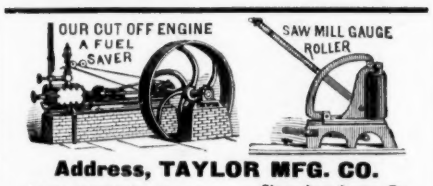

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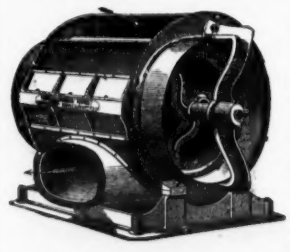

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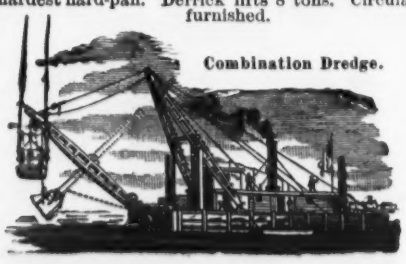

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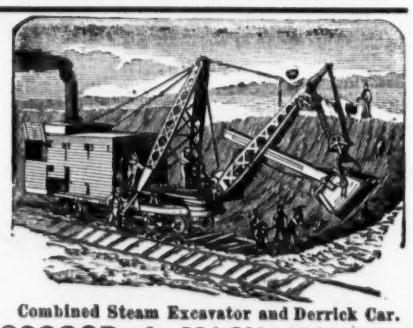

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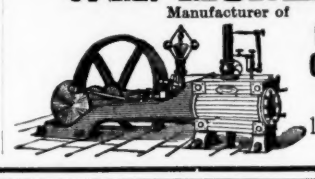

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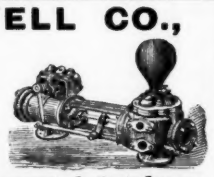

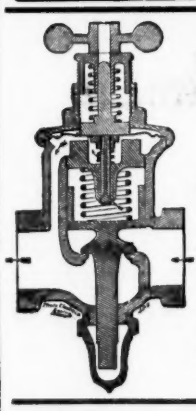

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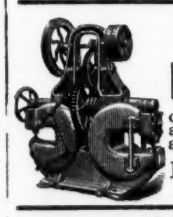

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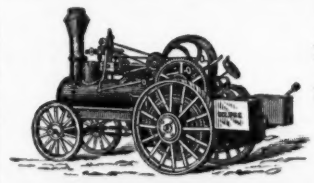

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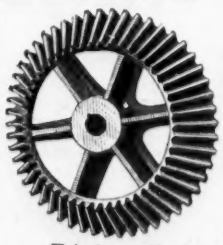

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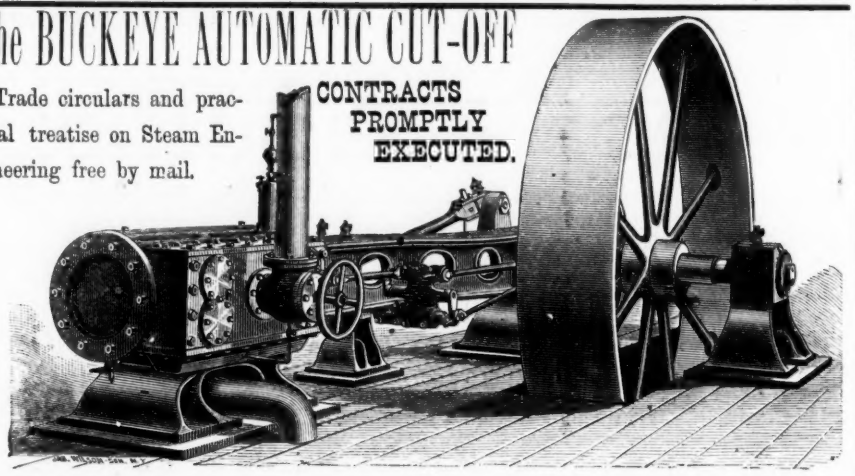

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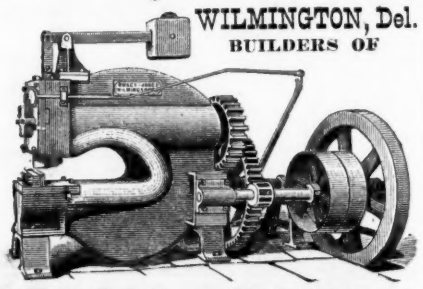

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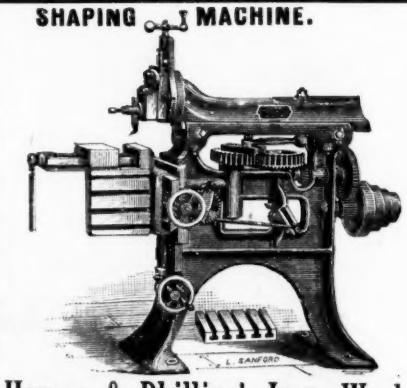

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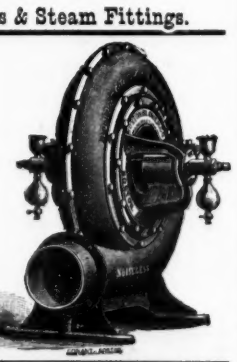

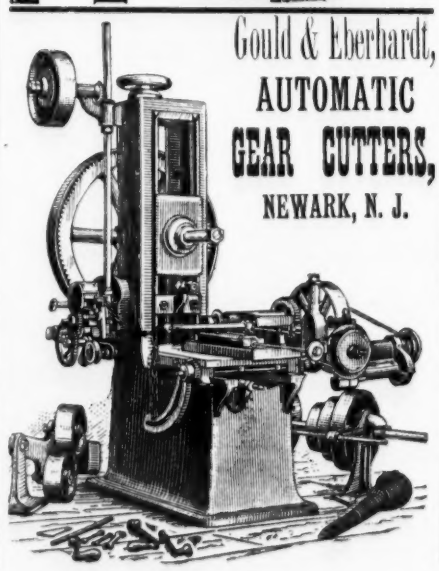

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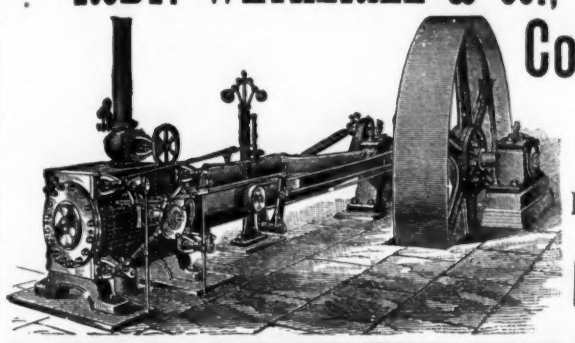

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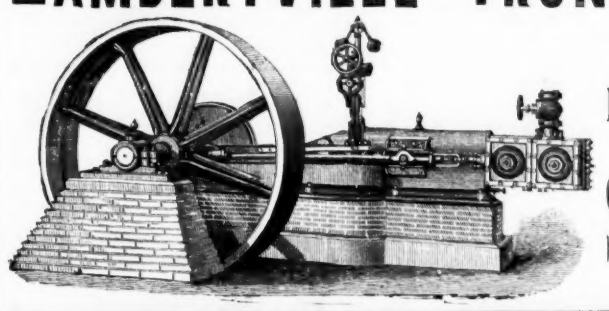

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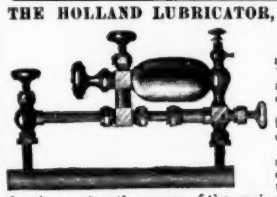

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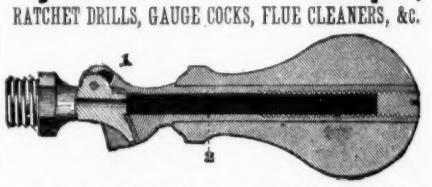

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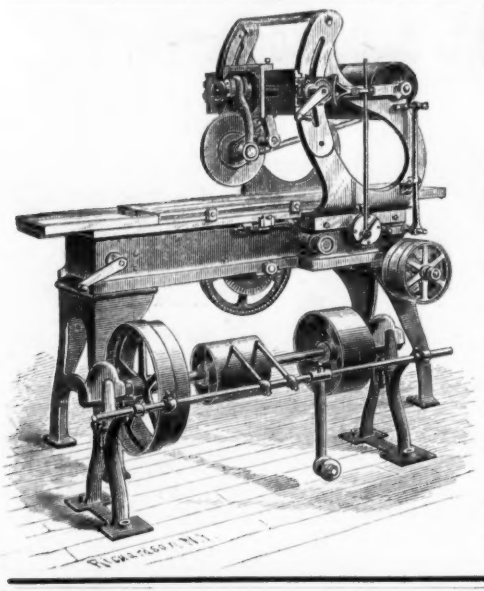

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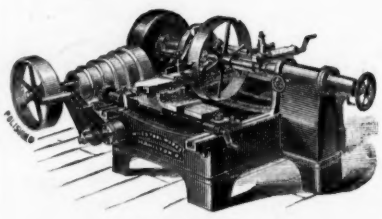

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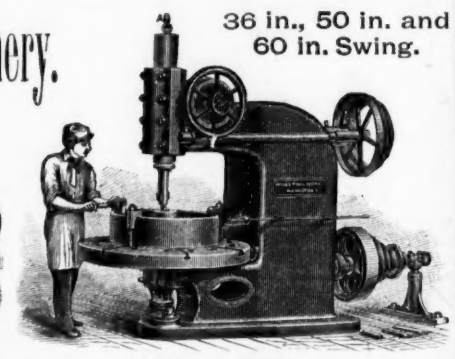

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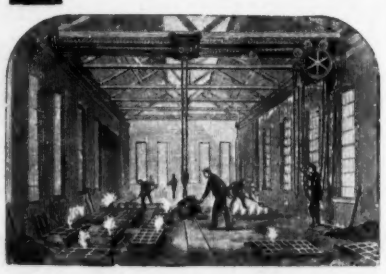

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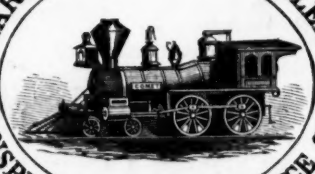

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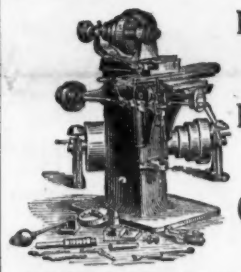

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